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Water-Supply Paper No. 211

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

SURFACE WATER SUPPLY
OF
COLORADO RIVER DRAINAGE ABOVE YUMA

1906

R. I. MEEKER
H. S. REED
DISTRICT HYDROGRAPHERS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1908

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SURFACE WATER SUPPLY OF THE COLORADO RIVER DRAINAGE ABOVE YUMA.[a]

R. I. **Meeker** and H. S. **Reed**,
District Hydrographers.

INTRODUCTION.

SCOPE OF WORK.

The water supply of the United States is of more importance to the life and pursuits of the people than any other natural resource. In the arid States the limit of agricultural development is determined by the amount of water available for irrigation, while in all parts of the country the increase in the population of cities and towns makes necessary additional water supplies for domestic and industrial uses, in procuring which both the quantity and the quality of the water that may be obtained must be considered. The location of manufacturing plants may depend largely on the water-power facilities and on the character of the water. The notable advances made in the electric transmission of power have led to the utilization of water powers for the operation of manufacturing establishments, railroads, and municipal lighting plants, many of which are at some distance from the places at which the power is developed.

The intelligent establishment and maintenance of enterprises or industries that depend on the use of water demands a thorough knowledge of the flow of the streams and an understanding of the conditions affecting that flow. This knowledge should be based on data showing both the total flow and the distribution of the flow throughout the year, in order that normal fluctuations may be provided for. As the flow of a stream is variable from year to year, estimates of future flow can be made only from a study of observations covering several years. The rapid increase in the development of the water resources of the United States has caused a great demand by engineers for information in regard to the flow of streams, as it is now generally realized that the failure of many large power, irrigation, and other projects has been due to the fact that the plans were made without sufficient trustworthy information in respect to the water supply.

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[a] This report contains information similar to that published in previous years under the title "Report on the Progress of Stream Measurements."

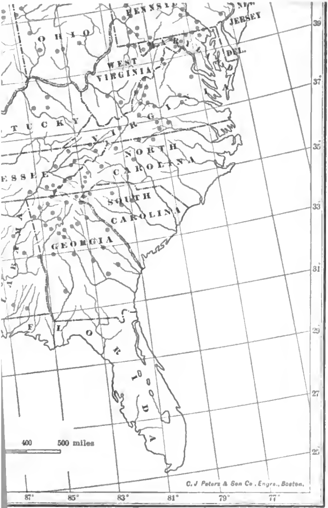
Owing to the broad scope of these hydrographic investigations and the length of time they should cover in order that the records may be of greatest value, it is in general impossible for private individuals to collect the necessary data, and as many of the streams traverse more than one State this work does not properly fall within the province of the State authorities. The United States Geological Survey has, therefore, by means of specific appropriations by Congress, for several years systematically made records of stream flow, with the view of ultimately determining all the important features governing the flow of the principal streams of the country. In carrying out this plan stations are established on the streams and maintained for a period long enough to show their regimen or general behavior. When a record that is sufficient for this purpose has been obtained for any stream, the work on that stream is discontinued. The order in which the streams are measured is determined by the degree of their importance.

During 1906 the regimen of flow was studied at about 700 stations distributed along the various rivers throughout the United States, as shown on Pl. I. In addition to these records data in regard to precipitation, evaporation, water power, and river profiles were obtained in many sections of the country.

These data have been assembled by drainage areas and are published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 201 to 214, inclusive, each of which pertains to the surface water resources of a group of adjacent areas. In these papers are embodied not only the data collected in the field, but also the results of computations based on these data and other information that has a direct bearing on the subject, such as descriptions of basins and the streams draining them, utility of the water resources, etc. The list follows.

Water-Supply and Irrigation Papers on surface water supply, 1906.

201. Surface water supply of New England, 1906. (Atlantic coast of New England drainage.)
202. Surface water supply of the Hudson, Passaic, Raritan, and Delaware river drainages, 1906.
203. Surface water supply of the Middle Atlantic States, 1906. (Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.)
204. Surface water supply of the Southern Atlantic and Eastern Gulf States, 1906. (Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages.)
205. Surface water supply of the Ohio and lower eastern Mississippi river drainages, 1906.


PENNSYLVANIA
NEW JERSEY
OHIO
MARYLAND
DEL.
WEST VIRGINIA
VIRGINIA
TUCKY
NORTH CAROLINA
ESSEE
SOUTH CAROLINA
GEORGIA
FLORIDA
39
37
35
33
31
29
27
25
87°
85°
83°
81°
79°
77°
400
500 miles
C. J Peters & Son Co., Engrs., Boston.

RING 1906.

206. Surface water supply of the Great Lakes and St. Lawrence River drainages, 1906.
207. Surface water supply of the upper Mississippi River and Hudson Bay drainages, 1906.
208. Surface water supply of the Missouri River drainage, 1906.
209. Surface water supply of the lower western Mississippi River drainage, 1906.
210. Surface water supply of the western Gulf of Mexico and Rio Grande drainages, 1906.
211. Surface water supply of the Colorado River drainage above Yuma, 1906.
212. Surface water supply of the Great Basin drainage, 1906.
213. Surface water supply of California, 1906. (The Great Basin and Pacific Ocean drainages in California and Colorado River drainage below Yuma.)
214. Surface water supply of the North Pacific Coast, 1906.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing such records up to and including 1903 has been published in Water-Supply Paper No. 119. The following table gives, by years and primary drainage basins, the numbers of the papers on surface water supply published from 1901 to 1906:

Numbers of Water-Supply Papers containing results of stream measurements, 1901–1906.[a]

	1901.	1902.	1903.	1904.	1905.	1906.
	No.	*No.*	*No.*	*No.*	*No.*	*No.*
Atlantic coast of New England drainage	65 75	82	97	124	165	201
Hudson, Passaic, Raritan, and Delaware river drainages	65 75	82	97	125	166	202
Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages	65 75	82 83	97 98	126	167	203
Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages	65 75	83	98	127	168	204
Ohio and lower eastern Mississippi river drainages	65 75	83	98	128	169	205
Great Lakes and St. Lawrence River drainages	65	83	97	129	170	206
Hudson Bay and upper eastern and western Mississippi River drainages	65 66 75	83 84 85	98 99 100	128 130	171	207
Missouri River drainage	66 75	84	99	130 131	172	208
Meramec, Arkansas, Red, and lower western Mississippi river drainages	66 75	84	99	131	173	209
Western Gulf of Mexico and Rio Grande drainages	66 75	84	99	132	174	210
Colorado River drainage, above Yuma	66 75	85	100	133	175	211
The Great Basin drainage	66 75	85	100	133	176	212
The Great Basin and Pacific Ocean drainages in California, and Colorado River drainage, below Yuma	66 75	85	100	134	177	213
North Pacific Coast drainage	66 75	85	100	135	178	214

[a] Reports containing data for years prior to 1901 are noted in the series list at the end of this paper

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot: One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION AND USE OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of monthly and yearly discharges and run-off.
6. Tables showing discharge and horsepower and the number of days during the year when the same are available.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of the hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The discharge measurements and gage heights are the base data from which the other tables are computed. In cases of extensive development it is expected that engineers will use these original data in making their calculations, as the computations made by the Survey are based on the data available at the time they are made and should be reviewed and, if necessary, revised when additional data are available.

The rating table gives the discharge in second-feet corresponding to various stages of the river as given by the gage heights. It is published to enable engineers to determine the daily discharge in case this information is desired.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the remaining columns, which are defined on page 4, are based.

The values in the table of monthly discharge are intended to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

In most work where data in regard to flow are used the regimen of flow is of primary importance. Therefore for the principal stations tables have been prepared showing the horsepower that can be developed at various rates of flow, and the length of time that these rates of flow and the corresponding horsepower are available. These tables have been prepared on a basis of 80 per cent efficiency on the turbines, and the horsepower per foot of fall is given in order that the reader can determine the horsepower for any fall.

In the computations sufficient significant figures have been used so that the percentage of error in the tables will not in general exceed 1 per cent. Therefore, most of the values in the tables are given to only three significant figures. In making the various computations Thatcher's slide rule, Crelle's tables, and computation machines have been generally used.

In order to give engineers an idea of the relative value of the various data notes in regard to accuracy are given as far as possible. This accuracy depends on the general local conditions at the gaging stations and the amount of data collected. Every effort possible is made to so locate the stations that the data collected will give a high degree of accuracy. This is not always possible, but it is considered better to publish rough values with explanatory notes rather than no data.

In the accuracy notes the following terms have been used, indicating the probable accuracy, in per cent, of the mean monthly flow. As these values are mean values, the error in the value for the flow of any individual day may be much larger.

Excellent indicates that the mean monthly flow is probably accurate to within 5 per cent; good, to within 10 per cent; fair, to within 15 per cent; approximate, to within 25 per cent.

CONVENIENT EQUIVALENTS.

Following is a table of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-feet.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.

1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of theoretical power.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief descriptions are given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; and (3) those with constantly shifting beds. In determining the daily flow special methods are necessary for each class. The data on which the determinations are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir, (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for *n* to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable measurements of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q = c\ b\ h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Papers Nos. 180 and 200[a]); (*f*) either no flashboards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such determinations of flow, the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the determinations of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

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[a] Water-Supply Paper No. 200 replaces No. 150, the edition of which has been exhausted.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the water surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. Their essential requirements are practically the same, whether the velocity is determined by meters or floats. They are located, as far as possible, where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and of dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats, as indicated by the distances from the bank, as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

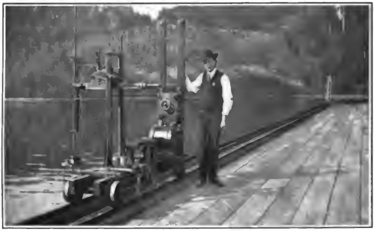
The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

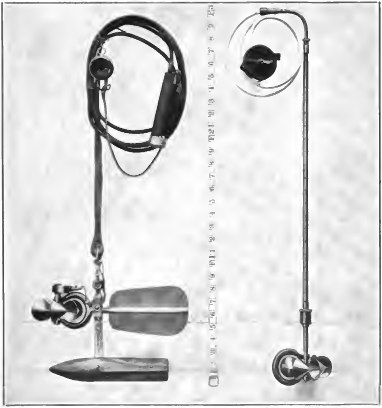
Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, shown in Pl. II, *B*, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing



A. CURRENT-METER RATING STATION, LOS ANGELES, CAL.



B. PRICE CURRENT METERS.

in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity-curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

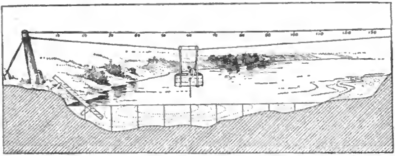


FIG. 1.—Cable station, showing section of river, car, gage, etc.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions, and moreover the indications are that it holds nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8, and vertical velocity-curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover see Water-Supply Paper No. 187.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of determining run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and the assumed coefficient the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant; (2) the discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected; (3) the discharge is a function of and increases gradually with the stage.

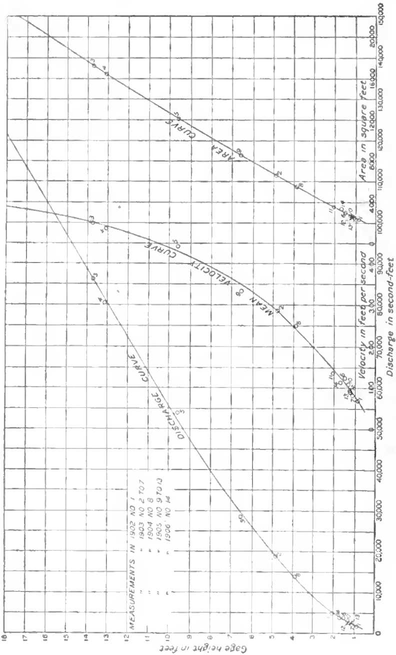


FIG. 2.—Discharge, area, and mean-velocity curves for Potomac River at Point of Rocks, Md.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical-velocity curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, the discharge can be determined by its use. In case of velocity-area stations frequent discharge measurements must be made if the determinations of flow are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in determining the flow at stations where the bed shifts but slowly.

ACKNOWLEDGMENTS.

Assistance has been rendered and records furnished by the following, to whom special acknowledgment is due: United States Reclamation Service, United States Weather Bureau, State engineer of Colorado, State engineer of Utah, Denver Union Water Company, Central Colorado Power Co.; and the following railroad companies: Denver and Rio Grande; Oregon Short Line; San Pedro, Los Angeles and Salt Lake; Colorado and Southern; Union Pacific; and Burlington.

COLORADO RIVER DRAINAGE BASIN.

GENERAL DESCRIPTION.

Colorado River is formed in the southeastern part of Utah by the junction of Grand and Green rivers. The Green is larger than the Grand and is the upward continuation of the Colorado. Including the Green the entire length of the Colorado is about 2,000 miles. The region drained is about 800 miles long, varies in width from 300 to 500 miles, and contains about 300,000 square miles. It comprises the southwestern part of Wyoming, the western part of Colorado, the eastern half of Utah, practically all of Arizona, and small portions of California, Nevada, New Mexico, and old Mexico. Most of this area is arid, the mean annual rainfall being about 8½ inches. The streams receive their supply from the melting snows on the high mountains of Wyoming, Utah, and Colorado.

There are two distinct portions of the basin of the Colorado. The lower third is but little above the level of the sea, though here and there ranges of mountains rise to elevations of 2,000 to 6,000 feet. This part of the valley is bounded on the north by a line of cliffs which present a bold, often vertical, step of hundreds or thousands of feet to the table-land above. The upper two-thirds of the basin stands from 4,000 to 8,000 feet above sea level, and is bordered on the east, west, and north by ranges of snow-clad mountains which attain altitudes varying from 8,000 to 14,000 feet above sea level. Through this plateau the Colorado and its tributaries have cut narrow gorges or canyons in which they flow at almost inaccessible depths. At points where lateral streams enter, the canyons are broken by narrow transverse valleys, diversified by bordering willows, clumps of box elder, and small groves of cottonwood. The whole upper basin of the Colorado is traversed by a labyrinth of these canyons, most of which are dry during the greater portion of the year, and carry water only during the melting of the snow and the brief period of the autumnal and spring rains.

As a matter of convenience the drainage area has been divided into three basins: (1) Green River basin, (2) Grand River basin, and (3) Colorado River below the junction of Grand and Green rivers, and each of these basins is subdivided to allow the separate description of branches of the main river.

GREEN RIVER DRAINAGE BASIN.

AREA AND EXTENT.

Green River and its tributaries drain an area rudely triangular in outline, bounded on the north and east by the Wind River Mountains and the ranges forming the Continental Divide, on the south and east by the White River Plateau and the Roan or Book Cliffs, and on the north and west by the Gros Ventre and Wyoming mountains and the great Wasatch Range. The greatest length of the basin, north and south, is about 370 miles. In an east-west direction it measures at its widest point about 240 miles. The total drainage area is approximately 41,000 square miles.

The area includes a large part of western Wyoming, northwestern Colorado, and eastern Utah. The Uinta and Uncompahgre Indian reservations are located in this basin in northeastern Utah.

As a matter of convenience the main river is described first and the tributary streams, beginning at the headwaters, afterwards.

GREEN RIVER.

DESCRIPTION OF BASIN.

Green River heads on the west slope of the Wind River Mountains in western Wyoming, its ultimate source being a number of small lakes fed by the glaciers and immense snow deposits always to be found on Fremont and neighboring peaks. For perhaps 25 miles the river flows northwestward through the mountains. It then turns abruptly and runs in a general southerly direction across western Wyoming into Utah. A few miles below the Wyoming-Utah boundary another sharp turn carries the river eastward along the Uinta

Mountains, through which it breaks near the east end of the range. It then flows southward in Colorado for about 25 miles, turns back into Utah, and continues to flow in a southwesterly and southerly direction until it unites with the Grand to form the Colorado. Its length, measured roughly along the course, is approximately 425 miles.

The topography of the headwater region is rugged in the extreme. The Wind River Range on the east and the Gros Ventre and Wyoming ranges on the northwest and west gradually close in as they extend southward, forming a basin comprising approximately 7,450 square miles in extent above the gaging station at Green River, Wyo. The upper part of this basin is very narrow, but southward the valley opens out; near Fontanelle, Wyo., it is several miles wide, with benches and rolling table-lands extending westward to the foothills of the Wyoming Range and eastward to the bluffs which hug the east bank of the river. At Green River the valley is again narrow—only a few hundred yards in width—and for some distance southward the river runs between bluffs standing so close together that no flood plain is seen. Throughout much of its course in Utah the Green flows through a succession of long, deep, narrow canyons, with walls ranging in height from a few hundred to as many thousand feet, separated by short valleys containing small tracts of arable lands.

In its upper course the Green receives as tributaries numerous streams heading in the Wind River, Gros Ventre, and Wyoming ranges of mountains, some of them extending so far back into the abrupt, ragged canyons that they dovetail with streams flowing in opposite directions. The most important of these tributaries are Newfork River, Big Sandy Creek, La Barge Creek, Fontanelle Creek, Black Fork, and Henry Fork. South of the Uinta Mountains the first large stream flowing into the Green is the Yampa, which comes in from the east at the point where the Green turns westward to reenter Utah after its southward journey in Colorado. Farther south Ashley Creek and Uinta and White rivers discharge their waters to the Green, Ashley Creek and the Uinta from the west and the White from the east. Below this point the only tributaries of importance are Minnie Maud Creek and San Rafael River, which enter from the west, the latter at a point about 32 miles above the junction of the Green and the Grand.

The geology of this basin is described in the Eleventh Annual Report of the United States Geological and Geographical Survey of the Territories for 1877, F. V. Hayden in charge, pages 509–646. Information in regard to the hydrography is contained in the first to fourth annual reports of the Reclamation Service and in other United States Geological Survey reports.

GREEN RIVER AT GREEN RIVER, WYO.

This station was established May 2, 1895, near the pump house at a point about 40 feet below the bridge of the Union Pacific Railroad, at Green River, Wyo. Since that date it has been maintained continuously, except for a few months during the winter and during the year 1900. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 14, where are given also references to publications that contain data for previous years.

Discharge measurements of Green River at Green River, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 4[a]	A. J. Parshall	161	589	1.50	873
April 26	do	278	921	2.85	3,040
May 5	do	246	804	2.65	2,580
May 22	do	284	1,150	3.35	4,200
June 1	do	284	1,540	4.10	6,910
June 24	do	284	1,500	3.90	6,340
July 5	do	284	1,370	3.70	5,470
July 27	do	284	1,090	3.10	3,480

[a] Right channel frozen over, no flow.

Daily gage height, in feet, of Green River at Green River, Wyo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.85	2.42	4.15	3.58	2.80	2.38	1.40
2	1.60	2.58	3.78	3.42	2.78	2.38	1.35
3	1.62	2.55	3.58	3.35	2.68	2.38	1.35
4	1.65	2.55	3.42	3.50	2.60	2.30	1.30
5	1.52	2.72	3.42	3.68	2.58	2.25	1.30
6	1.85	3.00	3.50	3.75	2.50	2.25	1.30
7	1.75	2.92	3.75	3.75	2.50	2.12	1.25
8	1.90	2.85	3.90	3.85	2.42	2.02	1.25
9	2.05	2.85	3.72	3.90	2.32	1.92	1.22
10	1.95	2.88	3.50	3.90	2.30	1.88	1.20
11	2.40	2.98	3.40	3.85	2.22	1.80	1.20
12	2.25	3.22	3.48	3.82	2.12	1.80	1.20
13	2.25	3.58	3.95	3.80	2.10	1.75	1.18
14	2.60	3.88	4.48	3.80	2.10	1.75	1.15
15	2.55	4.00	5.08	3.90	2.08	1.82	1.15
16	2.30	3.95	5.38	3.90	2.05	1.90	1.15
17	2.45	3.90	5.28	3.82	2.02	1.90	1.15
13	2.80	3.76	5.30	3.72	2.00	1.82	1.15
19	2.85	3.52	5.22	3.55	2.00	1.78	1.10
20	2.75	3.32	4.82	3.42	1.98	1.70	1.10
21	2.60	3.22	4.40	3.32	2.25	1.65	1.10
22	2.70	3.35	4.15	3.22	2.35	1.60	1.20
23	3.00	3.58	3.85	3.15	2.50	1.60	1.30
24	2.90	3.80	3.90	3.15	2.78	1.55	1.40
25	2.90	4.10	3.88	3.20	3.08	1.55	1.40
26	2.85	4.35	3.70	3.18	3.25	1.50	1.30
27	2.80	4.45	3.55	3.08	3.18	1.50	1.30
28	2.58	4.45	3.45	3.05	3.00	1.45	1.30
29	2.10	4.50	3.45	2.95	2.82	1.42	1.22
30	2.42	4.55	3.52	2.82	2.68	1.40	1.12
31		4.45		2.75	2.42		1.10

Rating table for Green River at Green River, Wyo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	560	1.90	1,290	2.70	2,630	3.50	4,830	4.60	8,900
1.20	635	2.00	1,410	2.80	2,860	3.60	5,160	4.80	9,730
1.30	710	2.10	1,540	2.90	3,100	3.70	5,500	5.00	10,570
1.40	790	2.20	1,690	3.00	3,360	3.80	5,850	5.20	11,430
1.50	875	2.30	1,850	3.10	3,630	3.90	6,210	5.40	12,200
1.60	965	2.40	2,020	3.20	3,910	4.00	6,570		
1.70	1,065	2.50	2,210	3.30	4,200	4.20	7,320		
1.80	1,175	2.60	2,410	3.40	4,510	4.40	8,100		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1906 and is well defined between gage heights 1.5 feet and 4.5 feet. It may not apply strictly from August to October, as conditions of flow may have changed after the last measurement.

Monthly discharge of Green River at Green River, Wyo., for 1906.

[Drainage area, 7,450 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	3,360	893	2,040	121,000	0.274	0.31
May	8,700	2,060	5,030	309,000	.675	.78
June	12,200	4,510	6,830	406,000	.917	1.02
July	6,210	2,740	4,860	299,000	.652	.75
August	4,060	1,390	2,240	138,000	.301	.35
September	1,990	790	1,260	75,000	.169	.19
October	790	560	660	40,600	.089	.10
The period				1,390,000		

NOTE.—Values are rated as follows: April to August, excellent; September and October, good.

GREEN RIVER AT JENSEN, UTAH.

This station was established November 7, 1903. It is located at Jensen post-office, about 300 feet below what is known as Billings Ferry, 15 miles from Vernal. The nearest railroad station, Dragon, Utah, is about 40 miles distant. Brush Creek enters the river 1½ miles above the station and Ashley Creek 3 miles below. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 17, where are given also references to publications that contain data for previous years.

Discharge measurements of Green River at Jensen, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	R. I. Meeker	475	2,580	6.63	7,500
June 4	do	530	4,750	9.95	20,100
June 26	do	520	4,030	8.41	14,300
July 21	T. E. Brick	308	2,860	6.10	8,620

Daily gage height, in feet, of Green River at Jensen, Utah, for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1		7.18	7.02	11.30	6.94	4.68	4.42
2		6.22	6.98	10.30	6.98	4.56	4.33
3		6.08	7.00	10.04	6.98	4.51	4.28
4		5.82	6.95	9.86	6.76	4.48	4.41
5		5.56	6.08	9.76	6.68	4.40	4.40
6		5.08	7.25	0.70	6.71	4.36	4.20
7		5.21	8.22	9.98	6.88	4.30	4.18
8		5.22	8.60	10.46	7.06	4.20	4.00
9		5.44	8.70	10.64	7.10	4.10	3.79
10		5.60	8.88	10.56	7.28	4.01	3.72
11		5.87	9.40	9.64	7.20	3.92	3.55
12		6.22	9.66	9.66	7.06	3.88	3.42
13	5.70	6.68	9.85	10.12	7.02	3.82	3.35
14	6.58	6.70	10.11	10.68	7.00	3.68	3.28
15	5.22	6.32	10.35	11.25	7.00	3.58	3.28
16	4.80	5.98	10.22	11.78	7.04	3.50	3.32
17	4.45	5.95	10.16	12.05	7.02	3.45	3.38
18	4.18	6.35	10.22	11.51	6.95	3.48	3.78
19	4.00	6.65	10.08	11.70	6.70	3.58	4.42
20	4.00	6.96	0.95	11.16	6.41	3.50	3.84
21	4.02	7.32	9.88	10.52	6.04	3.50	3.58
22	4.02	7.30	10.15	9.86	5.88	3.48	3.52
23	3.99	7.35	10.34	9.40	5.72	3.70	3.00
24	5.44	7.58	10.69	8.94	5.58	4.06	3.58
25	6.98	8.15	11.12	8.73	5.38	4.58	3.48
26	8.85	8.65	11.66	8.37	5.29	4.58	3.42
27	0.02	8.30	11.82	7.48	5.25	4.90	3.40
28	8.62	7.82	11.76	7.60	5.12	5.05	3.40
29	8.86	7.45	11.54	7.38	5.12	4.92	3.37
30	8.85	7.32	11.82	7.22	4.99	4.58	3.35
31	8.05		11.92		4.75	4.48	

Rating tables for Green River at Jensen, Utah.

MARCH 13 TO JULY 5, 1906[a]

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	2,000	5.00	3,800	6.00	6.200	7.00	9.000	9.00	16,100
4.10	2,150	5.10	4,010	6.10	6,470	7.20	9.610	0.20	16,920
4.20	2,310	5.20	4,230	6.20	6,740	7.40	10.240	9.40	17,760
4.30	2,480	5.30	4.450	6.30	7,010	7.60	10.900	9.60	18,620
4.40	2,650	5.40	4,680	6.40	7,290	7.80	11.590	9.80	19,500
4.50	2,830	5.50	4,920	6.50	7,570	8.00	12,300	16.00	20,400
4.60	3,010	5.60	5,160	6.60	7,850	8.20	13,030	11.00	25,100
4.70	3,200	5.70	5,410	6.70	8,130	8.40	13,770	12.00	30,000
4.80	3,390	5.80	5,670	6.80	8,410	8.60	14,530		
4.90	3,590	5.90	5,930	6.90	8,700	8.80	15,310		

JULY 6 TO OCTOBER 31, 1906.[b]

3.30	2,270	4.00	3,550	4.70	5,050	5.40	6,740	6.20	8,920
3.40	2,440	4.10	3,750	4.80	5,280	5.50	7,000	6.40	9,510
3.50	2,610	4.20	3,900	4.90	5,510	5.60	7,260	6.60	10,120
3.60	2,790	4.30	4,170	5.00	5,750	5.70	7,530	6.80	10,750
3.70	2,970	4.40	4,380	5.10	5,990	5.80	7,800	7.00	11,400
3.80	3,160	4.50	4,600	5.20	6,240	5.90	8,070	7.20	12,060
3.90	3,350	4.60	4,820	5.30	6,490	6.00	8,350		

[a] This table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906, and the form of the 1904 curve, and is well defined between gage heights 6.5 feet and 10 feet. From March 13 to about April 15, it may give values a little in excess of the true discharge.

[b] This table is applicable only for open-channel conditions. It is based on 1 discharge measurement made during 1906 and the form of the 1904 curve. It is not well defined and values obtained from it are liable to error on account of changing conditions of flow.

Monthly discharge of Green River at Jensen, Utah, for 1906.

[Drainage area, 26,600 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
March 13-31	16,200	1,960	7,340	276,000	0.276	0.19
April	14,700	3,970	8,070	480,000	.303	.34
May	29,600	8,850	19,400	1,190,000	.729	.84
June	30,200	9,670	20,400	1,210,000	.767	.86
July	12,300	5,160	9,230	568,000	.347	.40
August	5,870	2,520	3,850	237,000	.145	.17
September	4,420	2,240	3,080	183,000	.116	.13
The period				4,140,000		

NOTE.—Values are rated as follows: March to June, good; July to October, fair.

GREEN RIVER AT GREENRIVER, UTAH.

This station was established October 21, 1894, discontinued in November, 1896, and reestablished February 16, 1905. It is located at the Rio Grande Western Railway bridge at Greenriver (formerly Blake), Utah, in latitude 39° north, longitude 110° 9′ west, in the San Rafael quadrangle. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 19, where are given also references to publications that contain data for previous years. During 1906 the gage was read by W. E. Richards and G. C. Mead.

Discharge measurements of Green River at Greenriver, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	H. S. Kleinschmidt	462	2,770	6.60	10,400
May 17	E. C. Murphy	472	4,430	9.81	34,000
June 8	Thos. Grieve	472	4,440	9.80	33,600
June 29	do	466	3,820	8.50	22,600
October 19	do	400	1,780	4.60	3,170

Daily gage height, in feet, of Green River, at Greenriver, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.60	3.78	3.90	7.25	7.65	10.55	7.65	6.35	6.05	5.00	4.70	3.75
2	3.55	3.85	3.90	7.15	7.50	10.75	7.75	6.45	6.25	4.90	5.80	3.85
3	3.55	3.75	3.90	6.70	7.45	10.95	7.85	6.35	6.10	4.90	5.40	4.10
4	3.58	3.75	4.15	6.50	7.35	11.25	7.90	6.40	5.95	4.90	5.50	4.65
5	3.60	3.70	4.20	6.40	7.35	11.55	7.90	6.20	5.95	4.90	5.50	4.80
6	3.60	3.75	4.25	6.30	7.30	11.50	7.90	6.15	6.00	4.80	5.35	4.70
7	3.60	4.00	4.30	6.15	7.40	11.40	7.90	6.10	6.00	4.80	5.15	4.70
8	3.60	3.65	4.35	5.70	7.50	11.50	7.90	6.00	5.85	4.75	5.00	4.80
9	3.60	3.70	4.45	5.70	7.55	11.65	7.80	5.90	5.70	4.70	5.00	4.55
10	3.60	3.55	4.45	5.65	7.60	11.65	7.80	5.85	5.60	4.70	5.00	4.40
11	3.60	3.65	4.45	5.85	8.25	11.35	7.90	5.75	5.55	4.70	5.00	4.30
12	3.60	3.60	4.75	6.15	8.60	11.15	7.90	5.60	5.40	4.70	4.95	4.45
13	3.70	3.55	5.10	6.10	8.85	10.05	7.85	5.60	5.30	4.70	4.90	4.40
14	3.80	3.55	5.60	6.10	9.35	9.70	7.80	5.60	5.20	4.60	4.90	4.30
15	3.80	3.65	5.70	6.20	10.05	9.50	7.80	5.65	5.15	4.60	4.80	4.40

Daily gage height, in feet, of Green River, at Greenriver, Utah, for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.80	3.65	5.65	6.55	10.30	9.35	7.75	5.50	5.35	4.60	4.80	4.35
17	3.80	3.60	5.50	6.50	10.20	9.25	7.70	5.50	5.25	4.60	4.80	4.20
18	3.80	3.60	5.30	6.45	10.10	9.40	7.70	5.45	5.40	4.60	4.75	4.10
19	4.30	3.75	5.20	6.50	10.20	9.40	7.60	5.30	5.60	4.50	4.70	4.00
20	4.45	3.80	5.00	6.55	10.10	9.35	7.65	5.30	5.35	4.50	4.55	3.85
21	3.85	3.85	4.65	6.45	10.15	9.50	7.55	5.40	5.35	4.50	4.35	3.80
22	3.50	3.85	4.85	6.80	10.25	9.45	7.40	5.70	5.65	4.60	4.20	3.85
23	3.85	3.85	5.15	7.15	10.35	9.30	7.25	6.05	5.40	4.60	3.90	3.85
24	3.85	3.85	5.50	7.35	10.45	9.40	7.00	6.25	5.30	4.60	3.80	3.85
25	3.85	3.85	5.85	7.45	10.45	9.45	6.90	5.95	5.30	4.60	3.90	4.15
26	3.85	3.85	6.75	7.60	10.45	9.55	6.90	5.80	5.20	4.60	4.20	4.40
27	3.85	3.85	7.75	7.55	10.35	9.65	6.75	5.75	5.10	4.55	4.30	4.40
28	3.85	3.80	8.85	7.70	10.45	9.45	6.70	5.95	5.05	4.50	4.25	4.40
29	3.75	....	8.65	8.10	10.60	9.25	6.60	6.00	5.00	4.40	4.05	4.50
30	3.78	....	8.40	7.85	10.75	9.40	6.45	6.15	5.00	4.50	3.85	4.45
31	3.75	....	8.05	....	10.90	....	6.40	6.05	....	4.60	....	4.60

NOTE.—There was probably some ice obstruction during January, February and March. During the high stages the gage heights obtained by the hydrographers do not agree with those recorded by the observer for the same dates. For this reason discharges based on the above high gage heights are liable to large error.

Rating table for Green River at Greenriver, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.50	1,390	4.60	3,140	5.70	6,480	6.80	11,470	8.80	25,080
3.60	1,510	4.70	3,370	5.80	6,870	6.90	12,000	9.00	26,780
3.70	1,640	4.80	3,610	5.90	7,270	7.00	12,550	9.20	28,500
3.80	1,770	4.90	3,870	6.00	7,680	7.20	13,700	9.40	30,240
3.90	1,910	5.00	4,150	6.10	8,110	7.40	14,910	9.60	32,000
4.00	2,050	5.10	4,440	6.20	8,550	7.60	16,180	9.80	33,800
4.10	2,200	5.20	4,740	6.30	9,010	7.80	17,510	10.00	35,600
4.20	2,360	5.30	5,060	6.40	9,480	8.00	18,900	11.00	45,040
4.30	2,530	5.40	5,390	6.50	9,960	8.20	20,340	12.00	55,000
4.40	2,720	5.50	5,740	6.60	10,450	8.40	21,840		
4.50	2,920	5.60	6,100	6.70	10,950	8.60	23,420		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and the form of the 1905 curve. It is well defined between gage heights 4.5 feet and 10 feet.

Monthly discharge of Green River at Greenriver, Utah, for 1906.

[Drainage area, 38,200 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	2,820	1,450	1,720	106,000	0.045	0.05
February	2,050	1,450	1,690	93,900	.044	.05
March	25,500	1,910	6,970	429,000	.182	.21
April	19,600	6,290	11,200	666,000	.293	.33
May	44,100	14,300	29,500	1,810,000	.772	.89
June	51,500	28,900	37,600	2,240,000	.984	1.10
July	18,200	9,480	15,600	959,000	.408	.47
August	9,720	5,060	7,230	445,000	.189	.22
September	8,780	4,150	5,870	349,000	.154	.17
October	4,150	2,720	3,290	202,000	.086	.10
November	6,870	1,770	3,600	214,000	.094	.10
December	3,610	1,700	2,570	158,000	.067	.08
The year	51,500	1,450	10,600	7,670,000	.276	3.77

NOTE.—The above values must be used with a great deal of caution as they are considered only rough approximations. It is probable that the discharge for January, February, and March is much too high owing to ice conditions, for which no corrections could be made on account of lack of data. April and May can be considered approximate. June is known to be far too high (compare observers' and hydrographers' gage heights on days of measurements), and May is probably too high, also, but to a less extent. It is believed that the remainder of the year can be accepted as fair.

MISCELLANEOUS MEASUREMENTS IN GREEN RIVER DRAINAGE BASIN.

Fontenelle Creek is tributary to Green River about 50 miles above Green River, Wyo.

The following measurement was made May 31, 1906:

Width, 40 feet; area, 99 square feet; gage height, 3.05 feet; discharge, 374 second-feet.

NEWFORK RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Newfork River and its tributaries drain a portion of the western slopes of the Wind River Range, extending from Fremont Peak southeastward to Mount Bonneville, Mount Geikie, and Twin Buttes. The main stream flows in a general southerly course to a point near Cora, Wyo., where it turns sharply to the southwest, joining Green River about 40 miles below.

The entire length of the Newfork does not exceed 50 miles. The basin as a whole is triangular in shape and comprises approximately 1,100 square miles. Forests, in some places dense, cover about 300 square miles. Pines predominate, but aspens and firs are also found.

Pine, Pole, and Boulder creeks and Eastfork River are the chief tributaries of the Newfork. These are all small streams, heading far back among the high peaks of the range and fed by the numerous springs and small mountain lakes with which the region is dotted. Fremont, Boulder, Fayette, Half Moon, Burnt, and Meadow lakes are the largest and most important of these. Fremont Lake, through which Pine Creek flows, has an area of approximately 2,500 acres. The outlet is narrow and a dam at this point might be made to raise the water surface about 30 feet. Such a dam would probably store all the surplus waters of the creek. Boulder Creek flows through Boulder Lake. The outlet of this lake also is narrow, and a dam to raise the surface of the lake about 5 feet is in process of construction. In the drainage area of Pole Creek there are said to be no less than 40 small settling basins.

PINE CREEK NEAR PINEDALE, WYO.

This station was established on the stream April 25, 1904. It was located about one-fourth mile west of Pinedale, but this location not proving entirely satisfactory, it was abandoned at the close of the season, and April 2, 1905, was reestablished near the Hansen ranch, 1 mile above Pinedale, in sec. 28, T. 34 N., R. 109 W.

During 1906, discharge measurements were made from a bridge 1 mile below the gage, where the section is more favorable. During the irrigating season two ditches divert water from the river between the gage and the measuring section. The gage is read by Mrs. J. J. Hansen.

The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 23, where are given also references to publications that contain data for previous years.

Discharge measurements of Pine Creek near Pinedale, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 29	A. J. Parshall	35	47	1.20	52
May 2	do	45	60	1.25	71
May 25	do	92	143	2.00	378
May 29	do	96	165	2.30	574
June 16	G. N. Stadin	100	241	2.90	1,190
June 17	do	100	254	3.00	1,320
June 27	A. J. Parshall	98	198	2.45	[a] 739
July 2	do	98	196	2.40	[a] 704

[a] Includes discharge of two ditches which divert water between the gage and the measuring section.

Daily gage height, in feet, of Pine Creek near Pinedale, Wyo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.1	1.2	2.2	2.4	2.1	2.0	1.0
2	1.1	1.2	2.2	2.4	2.15	1.9	1.0
3	1.1	1.2	2.1	2.5	2.0	1.9	1.0
4	1.1	1.2	2.0	2.6	2.0	1.8	1.0
5	1.1	1.2	2.0	2.65	2.0	1.8	1.0
6	1.1	1.25	2.0	2.7	2.0	1.8	1.0
7	1.1	1.25	2.0	2.7	2.0	1.7	1.0
8	1.1	1.25	2.0	2.75	1.9	1.7	1.0
9	1.1	1.25	2.0	2.75	1.0	1.7	1.0
10	1.1	1.25	2.0	2.8	1.8	1.7	1.0
11	1.1	1.35	2.0	2.8	1.75	1.65	1.05
12	1.05	1.4	2.2	2.8	1.7	1.6	1.1
13	1.1	1.5	2.3	2.8	1.7	1.2	1.1
14	1.1	1.55	2.6	2.9	1.65	1.1	1.1
15	1.05	1.6	2.75	2.85	1.7	1.1	1.1
16	1.05	1.7	2.9	2.8	1.7	1.05	1.1
17	1.05	1.7	3.0	2.75	1.7	1.05	1.0
18	1.1	1.7	3.0	2.7	1.7	1.05	1.0
19	1.1	1.7	3.0	2.65	1.65	1.0	1.0
20	1.1	1.7	2.9	2.6	1.65	1.0	1.0
21	1.1	1.8	2.8	2.5	1.7	1.0	1.0
22	1.1	1.8	2.75	2.5	1.95	1.0	1.0
23	1.1	1.8	2.7	2.5	2.15	1.0	1.0
24	1.1	1.9	2.7	2.5	2.25	1.0	1.0
25	1.1	2.0	2.55	2.5	2.25	1.0	1.0
26	1.1	2.1	2.5	2.4	2.25	1.0	1.0
27	1.1	2.1	2.45	2.3	2.25	1.0	1.0
28	1.1	2.2	2.45	2.3	2.2	1.0	1.0
29	1.1	2.3	2.45	2.2	2.2	1.0	1.0
30	1.1	2.3	2.4	2.2	2.15	1.1	1.0
31	....	2.25	....	2.15	2.1	....	1.0

Rating table for Pine Creek near Pinedale, Wyo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	18	1.50	145	2.00	378	2.50	770	3.00	1,320
1.10	34	1.60	182	2.10	443	2.60	870		
1.20	55	1.70	223	2.20	515	2.70	970		
1.30	81	1.80	269	2.30	594	2.80	1,080		
1.40	111	1.90	320	2.40	679	2.90	1,200		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1906 and is well defined above gage height 1.2 feet.

Monthly discharge of Pine Creek near Pinedale, Wyo., for 1906.

[Drainage area, 130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	34	26	32.9	1,960	0.253	0.28
May	594	55	228	14,000	1.75	2.02
June	1,320	378	745	44,300	5.73	6.39
July	1,200	479	859	52,800	6.61	7.62
August	554	202	359	22,100	2.76	3.18
September	378	18	118	7,020	.908	1.01
October	34	18	20.8	1,280	.160	.18
The period				143,000		

NOTE.—Values are rated as follows: April and October, fair; May and September, good; June to August, excellent.

POLE CREEK AT FAYETTE, WYO.

This station was established April 22, 1904. It is located at a point opposite and about 300 yards distant from Fayette post-office, in sec. 9, T. 33 N., R. 108 W. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 25, where are given also references to publications that contain data for previous years.

Discharge measurements of Pole Creek at Fayette, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 30	A. J. Parshall	[a] 42	[a] 44	1.50	75
May 2	do	[a] 45	[a] 48	1.60	86
May 26	do	70	117	2.75	529
May 28	do	71	120	2.80	556
June 15	G. N. Stadin	72	181	3.30	996
June 18	do	72	163	3.15	826
June 29	A. J. Parshall	70	89	2.32	302
July 2	do	70	96	2.40	338

[a] Wading section.

Daily gage height, in feet, of Pole Creek at Fayette, Wyo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.5	1.55	2.45	2.35	1.9	2.1	1.3
2	1.5	1.6	2.35	2.35	1.9	2.1	1.3
3	1.5	1.65	2.25	2.35	1.85	2.0	1.3
4	1.5	1.7	2.2	2.35	1.85	2.0	1.3
5	1.5	1.7	2.2	2.55	1.85	1.95	1.3
6	1.5	1.7	2.25	2.65	1.8	1.9	1.3
7	1.5	1.75	2.25	2.65	1.75	1.9	1.3
8	1.5	1.8	2.3	2.65	1.75	1.9	1.3
9	1.5	1.85	2.2	2.65	1.75	2.0	1.3
10	1.5	1.9	2.2	2.65	1.6	2.2	1.3
11	1.5	2.05	2.25	2.6	1.65	2.2	1.2
12	1.1	2.15	2.8	2.55	1.65	2.9	1.2
13	1.1	2.35	3.3	2.55	1.65	2.85	1.2
14	1.1	2.5	3.3	2.55	1.65	2.8	1.2
15	1.1	2.55	3.3	2.5	1.6	2.8	1.25

Daily gage height, in feet, of Pole Creek at Fayette, Wyo., for 1906—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
16	1.1	2.5	3.25	2.5	1.6	2.75	1.15
17	1.1	2.5	3.3	2.4	1.55	2.6	1.1
18	1.15	2.4	3.2	2.35	1.55	2.45	1.1
19	1.15	2.4	3.05	2.3	1.5	2.35	1.1
20	1.15	2.3	2.85	2.25	1.5	2.3	1.1
21	1.15	2.35	2.65	2.15	1.65	2.25	1.1
22	1.15	2.4	2.55	2.15	1.65	2.15	1.1
23	1.2	2.5	2.5	2.15	1.8	2.1	1.1
24	1.2	2.6	2.5	2.15	2.45	1.9	1.1
25	1.25	2.7	2.45	2.15	2.45	1.7	1.0
26	1.35	2.75	2.4	2.15	2.45	1.7	1.0
27	1.45	2.8	2,3	2.15	2.4	1.6	1.0
28	1.5	2.85	2.3	2.1	2.35	1.55	1.0
29	1.5	2.8	2.3	2.1	2.35	1.4	1.0
30	1.55	2.75	2.35	2.05	2.25	1.4	1.0
31	....	2.65	....	2.0	2.15	....	1.0

Rating table for Pole Creek at Fayette, Wyo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	19	1.50	76	2.00	190	2.50	383	3.00	710
1.10	27	1.60	94	2.10	221	2.60	440	3.10	795
1.20	36	1.70	114	2.20	255	2.70	500	3.20	885
1.30	47	1.80	137	2.30	293	2.80	565	3.30	980
1.40	60	1.90	162	2.40	335	2.90	635		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–06 and is well defined between gage heights 1.0 feet and 3.0 feet.

Monthly discharge of Pole Creek at Fayette, Wyo., for 1906.

[Drainage area, 126 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	85	27	54.0	3,210	0.429	0.48
May	600	85	313	19,200	2.48	2.86
June	980	255	476	28,300	3.78	4.22
July	470	190	328	20,200	2.60	3.00
August	359	76	168	10,300	1.33	1.53
September	635	60	264	15,700	2.10	2.34
October	47	19	32.6	2,000	.259	.30
The period				98,900		

NOTE.—Values are rated as follows: April and October, good; remainder of the period, excellent.

BOULDER CREEK NEAR BOULDER, WYO.

This station was established April 23, 1904. It is located at the Coolidge ranch, about 1½ miles northeast of Boulder post-office, in sec. 4, T. 32 N., R. 108 W., and is below all diversion ditches. In the 1904 Progress Report this station was given as Boulder Creek near Newfork, Wyo. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 30, where are given also references to publications that contain data for previous years.

Discharge measurements of Boulder Creek near Boulder, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 1	A. J. Parshall	[a] 60	[a] 98	0.80	101
May 1	do	52	114	.80	100
May 26	do	81	265	2.90	1,040
May 28	do	80	256	[b] 2.70	883
June 15	G. N. Stadin	83	439	5.00	2,540
June 18	do	83	356	3.90	1,500
June 29	A. J. Parshall	77	240	2.25	684
July 1	do	77	242	2.25	683

[a] Wading section.

[b] A large tree lodged near gage probably raised the water surface slightly.

Daily gage height, in feet, of Boulder Creek near Boulder, Wyo., for 1906.

Day.	May.	June.	July.	Aug.	Sept	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	0.80	1.85	2.30	1.10	1.00	0.50	17	2.10	4.30	2.00	0.70	0.55	0.40
2	0.80	1.70	2.32	1.05	0.98	0.50	18	1.78	3.85	1.92	0.70	0.60	0.40
3	0.80	1.70	2.62	1.00	0.92	0.50	19	1.70	3.32	1.88	0.70	0.62	0.40
4	0.80	1.75	2.75	1.00	0.85	0.45	20	1.75	2.95	1.75	0.70	0.58	0.40
5	0.80	2.08	2.80	1.00	0.80	0.45	21	2.00	2.70	1.68	0.70	0.60	0.40
6	0.80	2.40	2.75	1.00	0.80	0.40	22	2.28	2.88	1.60	0.85	0.52	0.40
7	0.85	2.35	2.60	0.98	0.80	0.40	23	2.55	2.85	1.60	1.10	0.40	0.40
8	1.00	2.20	2.60	0.92	0.75	0.40	24	2.82	2.70	1.60	1.25	0.40	0.40
9	1.12	2.10	2.52	0.82	0.70	0.40	25	2.90	2.30	1.60	1.45	0.45	0.40
10	1.28	2.22	2.50	0.80	0.70	0.40	26	2.90	1.98	1.60	1.50	0.50	0.35
11	1.65	2.70	2.50	0.80	0.70	0.40	27	2.88	2.00	1.60	1.45	0.50	0.35
12	2.02	3.50	2.48	0.75	0.70	0.40	28	2.70	2.15	1.60	1.35	0.50	0.30
13	2.35	4.72	2.50	0.75	0.60	0.40	29	2.68	2.30	1.35	1.30	0.50	0.30
14	2.35	5.10	2.50	0.70	0.55	0.40	30	2.50	2.30	1.22	1.12	0.50	0,30
15	2.35	4.85	2.45	0.70	0.50	0.40	31	2.05	......	1.15	1.00	......	0.30
16	2.30	4.50	2.25	0.70	0.50	0.40							

Rating table for Boulder Creek near Boulder, Wyo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	18	1.10	189	1.90	515	2.70	915	3.80	1,615
0.40	29	1.20	224	2.00	560	2.80	970	4.00	1,760
0.50	42	1.30	263	2.10	605	2.90	1,030	4.20	1,910
0.60	58	1.40	304	2.20	655	3.00	1,090	4.40	2,060
0.70	77	1.50	345	2.30	705	3.20	1,210	4.60	2,220
0.80	100	1.60	387	2.40	755	3.40	1,340	4.80	2,380
0.90	127	1.70	429	2.50	805	3.60	1,475	5.00	2,540
1.00	157	1.80	472	2.60	860				

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined.

Monthly discharge of Boulder Creek near Boulder, Wyo., for 1906.

[Drainage area, 155 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
May	1,030	100	532	32,700	3.43	3.95
June	2,620	429	1,040	61,900	6.71	7.49
July	970	206	614	37,800	3.96	4.56
August	345	77	155	9,530	1.00	1.15
September	157	29	69.2	4,120	.446	.50
October	42	18	29.0	1,780	0.187	0.22
The period				148,000		

NOTE.—Values are rated as follows: May to August, good; September, fair; October, approximate.

EASTFORK RIVER AT NEWFORK, WYO.

This station was established April 1, 1905. It was originally located at a point about one-third mile southeast of Newfork post-office, in sec. 34, T. 32 N., R. 108 W. The conditions at this station are described in Water-Supply Paper No. 175, p. 32.

Owing to unsatisfactory conditions at this point the station was relocated May 1, 1906, at the county highway bridge one-fourth mile below.

There is but one channel, broken by two piers, and the banks are not liable to overflow. The bed of the stream is somewhat shifting. The channel is straight for 200 feet above and 100 feet below the station. The water is only sluggish at low stages. The river freezes solid during the winter.

Discharge measurements are made from the bridge. The initial point for soundings is at the gage on the left abutment.

The gage, which is read daily by Oliver N. Vible, is spiked to the left bridge abutment. The bench mark is a spike driven into the timber abutment of the bridge opposite the 6.50 feet mark on the gage.

Discharge measurements of Eastfork River at Newfork, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 1	A. J. Parshall	70	75	1.40	110
May 26	do	75	349	4.25	1,580
May 28	do	75	292	3.55	1,010
June 15	G. N. Stadin	75	382	4.75	1,740
June 18	do	75	298	3.60	1,050
June 29	A. J. Parshall	75	195	2.65	512
July 1	do	75	183	2.50	463

Daily gage height, in feet, of Eastfork River at Newfork, Wyo., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.40	2.50	2.30	1.45	1.30	1.10
2	1.40	2.40	2.60	1.40	1.20	1.10
3	1.35	2.60	2.75	1.45	1.20	1.10
4	1.45	3.00	2.80	1.50	1.20	1.10
5	1.60	3.60	2.65	1.40	1.20	1.10
6	1.65	3.95	2.50	1.40	1.15	1.10
7	1.70	3.30	2.80	1.35	1.10	1.10
8	1.80	2.60	2.75	1.30	1.10	1.10
9	2.10	2.60	2.50	1.25	1.00	1.00
10	2.70	3.20	2.40	1.25	1.10	1.00
11	3.40	4.25	2.35	1.20	1.10	1.00
12	3.80	4.70	2.30	1.25	1.00	1.00
13	3.50	5.18	2.40	1.25	1.10	1.00
14	3.20	5.38	2.45	1.20	1.10	1.00
15	3.25	4.72	2.30	1.15	1.10	1.00
16	3.00	4.25	2.10	1.15	1.10	1.00
17	2.60	4.28	2.00	1.10	1.15	1.00
18	2.50	3.55	1.95	1.15	1.10	1.00
19	2.60	3.05	1.90	1.10	1.10	1.00
20	3.00	2.85	1.80	1.10	1.10	1.00
21	3.65	2.80	1.70	1.60	1.10	1.00
22	3.80	2.85	1.75	2.00	1.10	1.00
23	4.15	2.75	1.55	2.10	1.10	1.00
24	4.10	2.50	1.55	2.00	1.10	1.00
25	4.15	2.15	1.60	1.85	1.10	1.00
26	4.25	2.12	1.65	1.75	1.10	1.00
27	3.65	2.18	1.60	1.60	1.10	1.00
28	3.55	2.40	1.55	1.50	1.10	1.00
29	3.80	2.55	1.50	1.40	1.10	1.00
30	3.10	2.32	1.40	1.35	1.10	1.00
31	2.70	.	1.50	1.35		1.00

Rating table for Eastfork River at Newfork, Wyo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	47	1.80	205	2.60	500	3.40	925	4.40	1,590
1.10	59	1.90	234	2.70	550	3.50	985	4.60	1,740
1.20	73	2.00	265	2.80	600	3.60	1,045	4.80	1,900
1.30	90	2.10	299	2.90	650	3.70	1,110	5.00	2,060
1.40	109	2.20	335	3.00	700	3.80	1,175	5.20	2,230
1.50	130	2.30	373	3.10	755	3.90	1,240	5.40	2,400
1.60	153	2.40	413	3.20	810	4.00	1,305		
1.70	178	2.50	455	3.30	865	4.20	1,445		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 7 discharge measurements made during 1906, and is well defined between gage heights 1.4 feet and 5 feet.

Monthly discharge of Eastfork River at Newfork, Wyo., for 1906.

[Drainage area, 320 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
May	1,480	100	713	43,800	2.23	2.57
June	2,380	306	887	52,800	2.77	3.09
July	600	109	321	19,700	1.00	1.15
August	299	59	120	7,380	.375	.43
September	90	47	61.6	3,670	.193	.22
October	59	47	50.1	3,080	.157	.18
The period				130,000		

NOTE.—Values are rated as follows: May to July, excellent; August, good; September and October, fair.

YAMPA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yampa River rises in Egeria Park, in the southeastern part of Routt County, Colo., runs in a generally northerly direction to Steamboat Springs, and thence westward to its point of junction with Green River, just east of the Colorado-Utah State boundary. Throughout almost its entire course it flows in a succession of open valleys alternating with deep, narrow canyons, the longest and deepest of the canyons being that through which it enters the Green.

The drainage basin of the river lies for the most part within the boundaries of Routt County, which is a little larger than the State of Massachusetts and comprises about 6,000 square miles. Its eastern limit is formed by the Park Mountains, and the melting of the snows on their high peaks is the source of numerous small streams whose waters augment the volume of the river and form its chief perennial supply. Westward from the mountains the basin is largely the eroded and dissected Yampa Plateau, whose wide terraces, abrupt cliffs, and deep-cut gulches and arroyos are the striking features of the region. The general level is over 6,000 feet above sea.

Elk River, Fortification Creek, Elk Head Creek, Williams River, and Little Snake River are the most important tributaries of the

Yampa. The upper basins of these streams are within the forested region, but along their lower courses are many cultivated areas.

YAMPA RIVER AT STEAMBOAT SPRINGS, COLO.

This station was established May 3, 1904, at the highway bridge at the east end of Steamboat Springs. May 8, 1905, it was reestablished at the new steel highway bridge, about one-fourth mile below the old bridge, in sec. 17, T. 6 N., R. 84 W. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 35, where are given also references to publications that contain data for previous years.

Discharge measurements of Yampa River at Steamboat Springs, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 29	A. A. Weiland	95	231	5.75	914
May 13	do	97	332	6.70	1,880
May 26	do	97	389	7.45	2,760
June 11	do	97	402	7.45	2,930
June 29	do	97	253	5.88	1,150
July 12	do	93	161	5.11	472
July 30	do	90	88	4.32	138
August 16	do	90	79	4.20	120
August 23	do	90	100	4.40	159

Daily gage height, in feet, of Yampa River at Steamboat Springs, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	4.68	5.68	7.15	5.60	4.45	4.25	4.38
2	4.78	5.52	7.28	5.55	4.45	4.35	4.38
3	4.75	5.62	7.35	5.38	4.45	4.48	4.38
4	4.65	5.85	7.40	5.10	4.38	4.38	4.38
5	4.65	6.38	7.65	5.10	4.40	4.28	4.38
6	4.78	6.38	7.98	5.10	4.42	4.28	4.38
7	4.92	6.05	7.10	5.55	4.42	4.28	4.38
8	5.00	6.35	6.65	5.38	4.42	4.28	4.38
9	5.00	6.65	7.08	5.25	4.38	4.28	4.38
10	5.28	6.80	7.62	5.25	4.30	4.28	4.38
11	5.50	6.88	8.05	5.20	4.28	4.28	4.38
12	5.50	0.88	8.45	5.20	4.22	4.28	4.38
13	5.15	6.90	8.60	5.12	4.30	4.28	4.38
14	4.95	6.65	8.48	5.08	4.70	4.30	4.38
15	5.20	6.65	8.30	5.08	4.50	4.40	4.35
16	5.42	6.85	8.10	4.95	4.45	4.52	4.32
17	5.75	7.05	7.45	4.80	4.40	4.60	4.32
18	5.80	7.05	7.32	4.75	4.40	4.60	4.32
19	5.80	7.30	7.15	4.72	4.40	4.60	4.32
20	5.92	7.45	6.75	4.65	4.42	4.60	4.32
21	6.15	7.55	6.72	4.60	4.42	4.60	4.32
22	6.50	7.70	6.78	4.58	4.42	4.55	4.32
23	6.45	7.65	6.48	4.50	4.42	4.45	4.32
24	6.82	7.55	6.15	4.50	4.42	4.40	4.32
25	6.25	7.70	6.05	4.50	4.42	4.40	4.38
26	6.10	7.48	6.05	4.50	4.32	4.38	4.40
27	6.05	7.32	6.02	4.45	4.28	4.38	4.42
28	5.98	7.78	5.75	4.38	4.28	4.38	4.38
29	5.75	8.25	5.80	4.38	4.25	4.38	4.38
30	5.78	7.50	5.72	4.35	4.25	4.38	4.38
31	....	7.10	....	4.30	4.25	....	4.38

Rating table for Yampa River at Steamboat Springs, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.20	110	5.10	475	6.00	1,140	6.90	2,130	7.80	3,350
4.30	140	5.20	535	6.10	1,235	7.00	2,260	7.90	3,495
4.40	170	5.30	595	6.20	1,335	7.10	2,390	8.00	3,640
4.50	205	5.40	660	6.30	1,435	7.20	2,520	8.20	3,940
4.60	240	5.50	730	6.40	1,540	7.30	2,655	8.40	4,245
4.70	280	5.60	805	6.50	1,650	7.40	2,790	8.60	4,555
4.80	325	5.70	885	6.60	1,765	7.50	2,925		
4.90	370	5.80	965	6.70	1,885	7.60	3,065		
5.00	420	5.90	1,050	6.80	2,005	7.70	3,205		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 9 discharge measurements made during 1906 and is well defined.

Monthly discharge of Yampa River at Steamboat Springs, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	2,030	260	813	48,400
May	4,020	745	2,220	136,000
June	4,560	901	2,500	149,000
July	805	140	398	24,500
August	280	116	166	10,200
September	240	125	171	10,200
October	177	146	159	9,780
The period				388,000

NOTE.—Values are rated as follows: April to July, excellent; August to October, good.

YAMPA RIVER NEAR CRAIG, COLO.

This station was established April 30, 1904. It is located on the wagon bridge 1 mile south of Craig, on the road to Meeker, Colo., in sec. 6, T. 6 N., R. 90 W., just below the mouth of Fortification Creek and about 7 miles above the mouth of Williams River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 37, where are given also references to publications that contain data for previous years.

Discharge measurements of Yampa River near Craig, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 26	A. A. Welland	167	1,020	5.34	3,560
May 2	do	166	895	4.77	2,550
May 10	do	190	1,240	6.90	6,260
May 27	do	191	1,440	7.20	7,130
June 13	do	191	1,460	7.55	8,150
July 10	do	166	965	4.38	2,370
July 27	do	131	672	2.94	650
August 14	do	131	615	2.50	411
August 22	do	131	602	2.40	371

Daily gage height, in feet, of Yampa River near Craig, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.5	4.8	6.6	4.75	2.6	2.0	2.4
2	3.3	4.7	6.6	4.8	2.7	2.0	2.3
3	3.4	4.7	6.6	4.7	2.75	2.1	2.3
4	3.15	4.85	6.75	4.55	2.65	2.2	2.3
5	3.4	5.6	6.8	4.4	2.6	2.2	2.3
6	3.3	6.0	7.35	4.15	2.6	2.1	2.3
7	3.9	5.8	7.6	4.4	2.55	2.15	2.3
8	3.5	5.9	6.3	4.5	2.55	2.05	2.3
9	3.5	6.2	5.9	4.35	2.5	2.0	2.3
10	4.05	6.7	6.25	4.25	2.55	2.0	2.3
11	4.25	7.0	6.9	4.35	2.5	2.15	2.25
12	4.3	6.95	7.3	4.25	2.4	2.0	2.2
13	4.1	6.7	7.6	4.15	2.3	2.1	2.2
14	3.65	6.4	7.95	4.05	2.3	2.05	2.2
15	3.9	6.3	7.95	4.25	2.4	2.15	2.2
16	4.05	6.5	7.6	4.1	2.45	2.25	2.2
17	4.4	6.9	7.6	3.8	2.4	2.15	2.2
18	4.55	7.0	7.1	3.6	2.35	2.1	2.2
19	4.55	7.05	6.35	3.45	2.4	2.05	2.2
20	4.55	7.25	6.25	3.3	2.35	2.35	2.2
21	4.8	7.5	5.9	3.25	2.35	2.35	2.2
22	5.1	7.6	5.9	3.15	2.4	2.4	2.2
23	5.35	7.65	5.8	3.1	2.3	2.45	2.2
24	5.6	7.55	5.45	3.0	2.35	2.55	2.2
25	5.85	7.6	5.1	3.1	2.35	2.5	2.2
26	5.3	8.0	4.9	3.0	2.25	2.45	2.2
27	5.2	7.3	4.9	2.9	2.25	2.4	2.2
28	4.9	7.2	4.9	2.8	2.15	2.45	2.25
29	4.65	7.75	4.8	2.7	2.1	2.5	2.3
30	4.75	8.35	4.65	2.65	2.1	2.5	2.3
31	....	7.15	....	2.6	2.05	....	2.3

Rating table for Yampa River near Craig, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	200	3.00	700	4.00	1,630	5.00	3,000	7.00	6,760
2.10	230	3.10	770	4.10	1,750	5.20	3,320	7.20	7,180
2.20	265	3.20	845	4.20	1,870	5.40	3,660	7.40	7,600
2.30	305	3.30	925	4.30	2,000	5.60	4,010	7.60	8,030
2.40	350	3.40	1,010	4.40	2,130	5.80	4,370	7.80	8,470
2.50	400	3.50	1,100	4.50	2,270	6.00	4,750	8.00	8,910
2.60	450	3.60	1,195	4.60	2,410	6.20	5,140	8.20	9,350
2.70	505	3.70	1,295	4.70	2,550	6.40	5,540	8.40	9,790
2.80	565	3.80	1,400	4.80	2,700	6.60	5,940		
2.90	630	3.90	1,510	4.90	2,850	6.80	6,340		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 9 discharge measurements made during 1906 and is well defined between gage heights 2.4 feet and 8 feet.

Monthly discharge of Yampa River near Craig, Colo., for 1906.

[Drainage area, 1,730 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	4,460	808	2,100	125,000	1.21	1.35
May	9,680	2,550	6,180	380,000	3.57	4.12
June	8,800	2,480	5,620	334,000	3.25	3.63
July	2,700	450	1,470	90,400	.850	.98
August	535	215	359	22,100	.208	.24
September	425	200	283	16,800	.164	.18
October	350	265	285	17,500	.165	.19
The period	....	....	....	986,000	....	....

NOTE.—The above values are good.

ELK RIVER NEAR TRULL, COLO.

This station was established May 2, 1904, and discontinued August 16, 1906. It is located about 2 miles southeast of Trull post-office, on the stage road between Steamboat Springs and Hayden, Colo., in sec. 32, T. 7 N., R. 85 W., and is below all tributaries. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 41, where are given also references to publications that contain data for previous years.

Discharge measurements of Elk River near Trull, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 28	A. A. Weiland	115	226	6.93	713
May 12	do	115	461	8.80	2,680
May 25	do	115	539	9.50	3,580
June 11	do	115	494	9.10	3,070
June 29	do	115	331	7.71	1,470
July 12	do	115	319	7.61	1,340
July 29	do	100	140	6.13	351
August 15	do	115	112	5.80	223
August 23	do	95	91	5.60	179

Daily gage height, in feet, of Elk River near Trull, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1		7.15	8.55	8.03	6.15	17		9.02	9.50	7.15	
2		7.05	8.80	8.18	6.12	18		8.78	8.78	7.03	
3		7.20	8.78	7.98	6.00	19		9.00	8.65	6.93	
4		7.70	8.65	7.88	5.95	20		9.30	8.55	6.75	
5		8.32	8.98	7.68	5.95	21		9.25	8.45	6.75	
6		8.28	9.68	7.53	5.90	22		9.42	8.55	6.63	
7		8.30	8.78	8.00	5.85	23		9.22	8.50	6.55	
8		8.40	8.25	7.76	5.80	24		9.28	8.22	6.63	
9		8.60	8.28	7.58	5.75	25		9.60	7.75	6.43	
10		8.82	8.78	7.70	5.70	26		9.05	7.75	6.33	
11		8.90	9.15	7.53	5.65	27		9.05	8.08	6.23	
12		8.92	9.42	7.66	5.60	28	6.90	9.22	8.08	6.20	
13		8.58	9.65	7.46	5.62	29	7.18	9.98	7.82	6.05	
14		8.55	9.58	7.53	5.75	30	7.32	9.05	7.98	6.15	
15		8.52	9.42	7.40	5.78	31		8.68		6.00	
16		8.82	9.52	7.30	5.62						

Rating table for Elk River near Trull, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.60	175	6.40	470	7.20	980	8.00	1,750	8.80	2,690
5.70	200	6.50	525	7.30	1,060	8.10	1,860	8.90	2,820
5.80	230	6.60	580	7.40	1,145	8.20	1,970	9.00	2,950
5.90	260	6.70	640	7.50	1,235	8.30	2,080	9.20	3,210
6.00	295	6.80	700	7.60	1,330	8.40	2,200	9.40	3,470
6.10	335	6.90	765	7.70	1,430	8.50	2,320	9.60	3,750
6.20	375	7.00	835	7.80	1,535	8.60	2,440	9.80	4,030
6.30	420	7.10	905	7.90	1,640	8.70	2,560	10.00	4,310

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1906 and is well defined.

Monthly discharge of Elk River near Trull, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	4,280	870	2,630	162,000
June	3,800	1,480	2,590	154,000
July	1,950	295	1,010	62,100
August 1-16	355	175	241	7,650
The period				386,000

NOTE.—The above values are excellent.

ELK HEAD CREEK NEAR CRAIG, COLO.

This station was established April 27, 1906, and was discontinued September 7, 1906. It is located at Harrison's ranch, 5¾ miles east of Craig, on the road to Hayden, and about 1 mile above the junction with the Yampa.

The channel curves both above and below the station. Above the bridge, the creek will overflow the flat bottom land on both banks; below the bridge the banks are high and not liable to overflow. The bed of the stream is of sand and mud and liable to shift. There is one channel at all stages.

Measurements are made from the lower side of a single-span iron highway bridge. The initial point for soundings is the inside face of the south abutment.

A chain gage is fastened to the downstream guard rail; length of chain, 16.10 feet. The gage was read by Margaret Harrison. The bench mark is a chiseled cross on the top of the northwest corner of the south abutment of the bridge; elevation, 13.25 feet above the datum of the gage.

Discharge measurements of Elk Head Creek near Craig, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 27	A. A. Weiland	40	116	6.44	301
May 1	do	40	108	6.30	268
May 11	do	64	325	9.90	1,050
May 27	do	63	242	8.72	803
June 10	do	40	118	6.60	306
June 29	do	27	40	4.40	29
July 11	do	28	42	4.45	31
July 31	do	25	32	4.03	4.8
August 14	do	25	35	3.90	3.5
August 22	do	25	31	3.70	2.9

Daily gage height, in feet, of Elk Head Creek near Craig, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1		6.28	7.78	4.42	3.90	3.65	17		9.88	5.80	4.25	3.75	
2		6.24	7.74	4.32	3.90	3.65	18		9.38	5.65	4.22	3.72	
3		6.22	7.50	4.30	3.90	3.68	19		9.70	5.48	4.20	3.65	
4		7.02	7.41	4.30	3.92	3.65	20		9.98	5.30	4.15	3.65	
5		8.45	7.34	4.19	3.92	3.65	21		9.84	5.09	4.14	3.65	
6		8.70	7.95	4.14	3.88	3.65	22		9.78	4.92	4.15	3.65	
7		8.06	7.35	4.12	3.75	3.64	23		9.32	4.88	4.10	3.65	
8		8.60	6.74	4.42	3.75		24		8.96	4.84	4.15	3.64	
9		9.45	6.52	4.32	3.75		25		9.48	4.84	4.18	3.60	
10		9.72	6.48	4.24	3.72		26		9.85	4.68	4.14	3.62	
11		9.95	6.50	4.25	3.70		27	6.35	8.80	4.54	4.15	3.62	
12		9.75	6.48	4.25	3.70		28	6.48	9.00	4.41	4.00	3.65	
13		8.62	6.40	4.30	3.70		29	6.25	9.68	4.40	3.98	3.65	
14		8.56	6.25	4.25	3.70		30	6.32	9.78	4.46	4.05	3.65	
15		8.91	6.02	4.25	3.75		31		8.35			3.65	
16		9.65	5.84	4.25	3.78								

Rating table for Elk Head Creek near Craig, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.60	2.6	4.50	36	5.40	138	6.30	282	7.40	509
3.70	2.9	4.60	45	5.50	151	6.40	301	7.60	552
3.80	3.2	4.70	55	5.60	165	6.50	321	7.80	596
3.90	3.5	4.80	65	5.70	180	6.60	341	8.00	640
4.00	4	4.90	76	5.80	195	6.70	362	9.00	860
4.10	7	5.00	88	5.90	211	6.80	383	10.00	1,080
4.20	12	5.10	100	6.00	228	6.90	404		
4.30	19	5.20	112	6.10	245	7.00	425		
4.40	27	5.30	125	6.20	263	7.20	467		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1906 and is well defined.

Monthly discharge of Elk Head Creek near Craig, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	1,080	267	840	51,600
June	629	27	257	15,300
July	29	4	13.5	830
August	3.6	2.6	3.0	184
September 1-7	2.8	2.7	2.8	38.9
The period				68,000

NOTE.—Values are rated as follows: May and June, good; remainder of the period, approximate.

FORTIFICATION CREEK AT CRAIG, COLO.

This station was established June 12, 1905, and was discontinued June 30, 1906. It is located at the highway bridge about one-fourth mile east of Craig, Colo., in sec. 6, T. 6 N., R. 90 W.

On May 2, 1906, a new chain gage was installed at the same datum as the staff gage; length of chain, 16.60 feet. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 43.

Discharge measurements of Fortification Creek at Craig, Colo., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1905.					
June 12	H. G. Graham	51	84	4.40	212
1906.					
May 2	A. A. Weiland	45	63	3.90	118
May 10	do	50	142	6.00	337
May 27	do	50	117	5.50	301
June 9	do	45	56	3.84	128
June 30	W. H. Rose	3		1.90	(a)

a Practically no flow.

Daily gage height and discharge of Fortification Creek at Craig, Colo., for 1905–6.

Day.	1905.		1906.				Day.	1905.		1906.			
	June.		May.		June.			June.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*		*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*	*Feet.*	*Sec.-feet.*
1	5.55	338			4.85	230	17	3.50	125	5.40	268	3.60	108
2	5.92	380	4.10	137	4.75	218	18	3.35	109	5.35	263	3.50	100
3	5.88	375	3.80	110	4.65	208	19	3.20	97	5.35	263	3.20	75
4	6.20	413	3.66	97	5.15	261	20	2.95	77	5.90	325	2.90	52
5	6.40	435	4.90	216	5.25	272	21	2.85	67	5.75	308	2.80	45
6	6.10	400	4.80	205	5.25	272	22	2.75	60	5.80	313	2.65	38
7	5.10	288	4.65	190	4.75	218	23	2.70	50	5.95	332	2.55	25
8	5.05	282	4.75	200	4.15	158	24	2.70	50	5.10	237	2.45	19
9	5.05	282	5.45	275	3.85	130	25		0	5.45	275	2.40	16
10	5.45	327	5.90	325	3.95	138	26		0	6.25	365	2.20	7
11	4.70	245	5.95	332	4.10	153	27		0	5.45	295	2.10	3
12	4.60	233	5.55	285	4.20	163	28		0	5.20	267	2.00	1
13	4.15	187	5.05	232	4.40	183	29		0	6.60	427	2.00	1
14	3.95	167	4.75	200	4.05	148	30		0	6.55	421	1.90	0
15	3.75	147	5.10	237	3.95	138	31			5.55	306		
16	3.70	143	5.60	293	3.70	116							

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Fortification Creek at Craig, Colo., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
June	435	40	176	10,500
1906.				
May 2-31	427	97	267	15,900
June	272	0	117	6,960

NOTE.—The above values are fair.

WILLIAMS RIVER AT HAMILTON, COLO.

This station was established April 29, 1904. It is located at the highway bridge at Hamilton, on the stage road from Meeker to Craig, Colo., about 17 miles from Craig, in sec. 20, T. 5 N., R. 91 W. The conditions at this station and the bench marks are described in

Water-Supply Paper No. 175, page 44, where are given also references to publications that contain data for previous years.

Discharge measurements of Williams River at Hamilton, Colo., by A. A. Weiland, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 25	50	145	4.22	501	June 9	60	225	5.62	2,000
April 25	50	154	4.18	458	June 28	58	183	4.60	616
May 2	40	110	3.68	220	July 10	45	121	3.85	297
May 9	55	191	5.22	1,010	July 26	40	84	3.13	98
May 10	60	247	6.10	1,370	August 13	40	82	3.05	88
May 23	60	301	6.80	1,740	August 21	40	84	3.10	91
May 28	60	349	7.18	2,090					

Daily gage height, in feet, of Williams River at Hamilton, Colo., for 1906.

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.60	3.72	5.68	4.27	2.97	2.90	2.95
2	3.32	3.72	5.88	4.20	3.15	3.10	2.90
3	3.10	3.80	5.75	4.10	3.00	3.10	2.87
4	3.12	4.20	5.72	4.00	3.07	3.10	2.95
5	3.22	5.08	6.05	3.93	3.05	2.93	2.93
6	3.20	4.92	6.92	3.85	3.05	2.93	2.93
7	3.30	4.82	5.90	4.07	3.05	2.90	2.90
8	3.18	5.10	5.35	3.95	3.03	2.77	2.90
9	3.18	5.45	5.50	3.87	2.95	2.75	2.90
10	3.25	5.90	6.08	3.80	2.95	2.80	2.85
11	3.45	6.22	6.25	3.80	2.87	2.75	2.85
12	3.40	6.22	6.48	3.70	2.85	2.73	2.80
13	3.08	5.55	6.70	3.83	2.95	2.70	2.75
14	3.15	5.25	6.62	3.83	3.25	2.80	2.75
15	3.15	5.42	6.35	3.83	3.20	3.10	2.70
16	3.30	6.32	6.30	3.65	3.05	3.40	2.70
17	3.50	6.75	6.25	3.55	3.07	3.20	2.65
18	3.55	6.65	5.65	3.45	3.27	3.05	2.63
19	3.48	6.95	5.42	3.40	3.10	3.05	2.70
20	3.55	7.38	5.25	3.35	3.05	3.05	2.90
21	3.75	7.25	5.05	3.30	3.07	3.05	2.90
22	3.92	7.35	5.12	3.25	2.97	3.07	2.95
23	4.25	7.22	5.05	3.20	2.95	3.00	2.93
24	4.62	6.42	4.65	3.15	2.95	2.93	2.80
25	4.32	6.40	4.55	3.07	2.93	2.90	3.00
26	4.00	6.38	4.55	3.10	2.95	3.00	2.97
27	3.80	6.32	4.55	3.10	3.00	3.20	2.97
28	3.80	7.15	4.45	3.03	2.90	3.07	2.88
29	3.82	8.12	4.38	3.05	2.85	3.03	2.77
30	3.82	6.40	4.35	3.10	2.93	2.95	2.75
31	....	5.80	....	3.00	2.93	....	2.70

Rating table for Williams River at Hamilton, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.60	25	3.50	186	4.40	536	5.30	965	6.40	1,565
2.70	35	3.60	218	4.50	580	5.40	1,015	6.60	1,675
2.80	47	3.70	253	4.60	625	5.50	1,070	6.80	1,790
2.90	60	3.80	290	4.70	670	5.60	1,125	7.00	1,910
3.00	75	3.90	328	4.80	715	5.70	1,180	7.20	2,030
3.10	92	4.00	368	4.90	765	5.80	1,235	7.40	2,150
3.20	111	4.10	409	5.00	815	5.90	1,290	7.60	2,270
3.30	133	4.20	451	5.10	865	6.00	1,345	7.80	2,390
3.40	158	4.30	493	5.20	915	6.20	1,455	8.00	2,510

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1906 and is well defined above gage height 3 feet.

Monthly discharge of Williams River at Hamilton, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	634	89	218	13,000
May	2,580	260	1,340	82,400
June	1,730	514	1,120	66,600
July	480	75	230	14,100
August	126	54	78.4	4,820
September	158	35	74.0	4,400
October	75	28	53.2	3,270
The period				189,000

NOTE.—The above values are good, except those for October, which are fair.

WHITE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

White River rises in Trappers Lake, which lies at an elevation of 9,500 feet above sea level in a small mountain basin of the White River Plateau in eastern Garfield County, Colo.; thence it flows westward to its point of junction with Green River in west-central Uinta County, Utah. Throughout its course it occupies a narrow, mountainous valley, with alternating parks and canyons, entering the longest and deepest of the canyons, in which it continues to its mouth, about 8 miles east of the Colorado-Utah State line.

The basin comprises an arid, broken, and much eroded plateau region, which topograhically is a continuation of the Grand River Mesa south of Grand River. The headwater portion covers the greater area and is called the White River Plateau; below this and to the south is the Roan, or Book Cliffs, Plateau. Fragmentary plateaus also occur along the northern side of the river.

Numerous small streams, among which are Marvine Creek and South Fork, join the White in the upper, mountainous portion of the basin. Douglas, Piceance, and Evacuation Creeks, draining the Book Cliffs Plateau, enter White River from the south. In the spring these creeks carry considerable water, derived mainly from melting snow, but in the summer they are very nearly dry.

The mean annual precipitation recorded at Meeker is 15.9 inches; farther west and at lower elevations it is undoubtedly much less.

NORTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

This station was established July 28, 1903. It is located at the county bridge at Rawson's ranch, below the mouth of Marvine Creek, 7 miles from Buford, the nearest post-office, and 32 miles from Meeker, Colo. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 50, where are given also references to publications that contain data for previous years.

Discharge measurements of North Fork of White River near Buford, Colo., by A. A. Weiland, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	83	136	2.55	547	July 7	83	144	2.60	630
May 18	83	186	3.20	1,040	July 20	83	114	2.25	397
June 5	83	191	3.18	1,060	August 6	83	97	2.05	318
June 25	83	170	2.90	899	August 29	83	91	1.98	296

Daily gage height, in feet, of North Fork of White River near Buford, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.82	2.08	2.95	2.78	2.18	2.02	2.00
2	1.82	2.08	2.95	2.78	2.12	2.05	1.95
3	1.80	2.15	2.95	2.68	2.10	2.00	1.95
4	1.82	2.42	2.95	2.65	2.10	2.00	1.95
5	1.82	2.65	3.05	2.60	2.10	2.00	1.90
6	1.85	2.70	3.05	2.55	2.10	2.00	1.90
7	1.82	2.60	2.95	2.60	2.08	2.00	1.90
8	1.82	2.80	3.00	2.58	2.08	2.00	1.90
9	1.82	3.02	3.15	2.50	2.08	2.00	1.90
10	1.88	3.20	3.32	2.50	2.08	2.00	1.90
11	1.88	3.20	3.35	2.50	2.08	1.98	1.90
12	1.85	2.85	3.45	2.48	2.08	1.98	1.90
13	1.88	2.68	3.60	2.42	2.10	1.98	1.90
14	1.88	2.70	3.75	2.42	2.08	2.00	1.90
15	1.88	2.98	3.85	2.40	2.05	2.08	1.90
16	1.92	3.22	3.90	2.40	2.05	2.10	1.90
17	2.02	3.22	3.80	2.35	2.08	2.05	1.90
18	2.05	3.25	3.50	2.32	2.15	2.02	1.90
19	2.00	3.55	3.42	2.30	2.08	2.02	1.90
20	2.05	3.48	3.35	2.30	2.05	2.00	1.90
21	2.18	3.60	3.25	2.25	2.05	2.00	1.90
22	2.30	3.40	3.32	2.22	2.05	2.00	1.92
23	2.40	3.35	3.30	2.22	2.05	2.00	1.90
24	2.30	3.25	2.95	2.20	2.05	2.00	1.90
25	2.22	2.95	2.95	2.15	2.00	2.00	1.88
26	2.15	2.95	2.90	2.15	2.00	2.05	1.88
27	2.08	3.25	2.82	2.15	2.00	2.02	.88
28	2.08	3.60	2.78	2.15	2.00	2.00	1.88
29	2.10	3.35	2.75	2.12	2.00	2.00	1.88
30	2.10	3.00	2.75	2.12	2.00	2.00	1.88
31	....	2.90	....	2.10	2.00	....	1.88

Rating tables for North Fork of White River near Buford, Colo.

APRIL 1 TO JUNE 16, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	135	2.30	390	2.80	740	3.30	1,195	3.70	1,610
1.90	180	2.40	450	2.90	825	3.40	1,295	3.80	1,720
2.00	225	2.50	515	3.00	910	3.50	1,400	3.90	1,835
2.10	275	2.60	585	3.10	1,000	3.60	1,505	4.00	1,950
2.20	330	2.70	660	3.20	1,095				

JUNE 17 TO OCT. 31, 1906.[b]

1.90	255	2.30	445	2.70	720	3.10	1,100	3.50	1,500
2.00	295	2.40	505	2.80	805	3.20	1,200	3.60	1,605
2.10	340	2.50	570	2.90	900	3.30	1,300	3.70	1,710
2.20	390	2.60	640	3.00	1,000	3.40	1,400	3.80	1,815

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and 3 during 1906, and is well defined below gage height 2.4 feet.

[b] This table is applicable only for open-channel conditions. It is based on 5 discharge measurements made after June 17, 1906, and is well defined below gage height 3 feet.

Monthly discharge of North Fork of White River near Buford, Colo., for 1906.

[Drainage area, 181 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	450	135	225	13,400	1.24	1.38
May	1,500	265	927	57,000	5.12	5.90
June	1,840	762	1,130	67,200	6.24	6.96
July	788	340	507	31,200	2.80	3.23
August	380	295	325	20,000	1.80	2.08
September	340	287	300	17,900	1.66	1.85
October	295	248	257	15,800	1.42.	1.64
The period				222,000		

NOTE.—Values are rated as follows: April and October, good; remainder of the period, excellent.

SOUTH FORK OF WHITE RIVER NEAR BUFORD, COLO.

This station was established July 25, 1903. It is located at the county bridge at the lower end of a section of the river known as "Stillwater," about 7 miles from Buford, the nearest post-office, and about 30 miles from Meeker, Colo., in T. 1 S., R. 91 W. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 52, where are given also references to publications that contain data for previous years.

Discharge measurements of South Fork of White River near Buford, Colo., by A. A. Weiland, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	53	97	2.95	383	July 8	53	133	3.60	643
May 19	53	141	3.75	724	July 23	53	98	2.97	286
June 7	53	192	4.50	1,310	August 8	53	76	2.70	257
June 26	53	186	4.30	1,200	August 31	53	68	2.55	222

Daily gage height, in feet, of South Fork of White River near Buford, Colo., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1		4.0	3.95	2.85	2.8	2.7	17	3.6	7.75	3.25	2.8	2.8	2.6
2		4.15	3.9	2.85	2.8	2.7	18	3.7	6.5	3.2	2.8	2.75	2.6
3		4.15	3.8	2.7	2.75	2.7	19	3.82	6.0	3.1	2.8	2.7	2.6
4		4.3	3.65	2.7	2.7	2.75	20	4.1	5.9	3.0	2.8	2.7	2.6
5		4.55	3.6	2.8	2.7	2.7	21	4.1	5.35	3.05	2.8	2.7	2.6
6		5.0	3.55	2.8	2.7	2.65	22	4.35	5.1	3.0	2.8	2.7	2.6
7	3.0	4.65	3.65	2.8	2.7	2.6	23	4.4	5.2	3.0	2.75	2.7	2.6
8	3.02	4.35	3.6	2.8	2.7	2.6	24	4.15	4.65	3.0	2.7	2.7	2.65
9	3.3	4.55	3.55	2.8	2.7	2.6	25	3.95	4.3	3.0	2.7	2.7	2.65
10	3.38	5.0	3.5	2.8	2.7	2.6	26	3.85	4.35	3.0	2.7	2.7	2.6
11	3.5	5.65	3.45	2.8	2.7	2.6	27	3.8	4.5	2.9	2.7	2.8	2.6
12	3.45	6.65	3.4	2.8	2.7	2.6	28	4.15	4.3	2.9	2.7	2.7	2.6
13	3.45	7.3	3.4	2.8	2.7	2.6	29	4.45	4.05	2.85	2.7	2.7	2.6
14	3.35	7.7	3.45	2.8	2.7	2.6	30	4.2	4.05	2.8	2.75	2.7	2.6
15	3.35	7.25	3.35	2.8	2.8	2.6	31	3.95		2.8	2.8		2.6
16	3.5	7.55	3.3	2.8	2.8	2.6							

Daily discharge, in second-feet, of South Fork of White River near Buford, Colo., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	960	950	270	305	270	17	650	3,740	430	305	305	235
2	.....	1,050	920	275	305	270	18	700	2,740	400	305	288	235
3	.....	1,050	800	270	288	270	19	760	2,300	360	305	270	235
4	.....	1,130	730	265	270	288	20	910	2,280	325	305	270	235
5	.....	1,340	710	280	270	270	21	910	1,880	320	305	270	235
6	.....	1,640	630	285	270	252	22	1,060	1,720	300	305	270	235
7	385	1,400	675	290	270	235	23	1,130	1,780	300	288	270	235
8	393	1,220	650	295	270	235	24	980	1,410	295	270	270	252
9	515	1,340	625	305	270	235	25	880	1,190	295	270	270	252
10	551	1,640	605	305	270	235	26	820	1,220	290	270	270	235
11	605	2,100	550	305	270	235	27	800	1,320	280	270	305	235
12	582	2,850	525	305	270	235	28	980	1,200	280	270	270	235
13	582	3,370	525	305	270	235	29	1,220	1,010	260	270	270	235
14	538	3,690	550	305	270	235	30	1,070	1,010	245	288	270	235
15	538	3,320	500	305	305	235	31	930	....	250	305	......	235
16	605	3,580	480	305	305	235							

NOTE.—These discharges prior to August 9 were obtained by the indirect method for shifting channels; after that date they are based on a rating table.

Monthly discharge of South Fork of White River near Buford, Colo., for 1906.

[Drainage area, 148 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec. ft. per sq. mile.	Depth in inches.
May 6-31	1,220	385	764	37,900	5.16	4.80
June	3,740	960	1,880	112,000	12.70	14.17
July	950	245	486	29,900	3.28	3.78
August	305	265	290	17,800	1.96	2.26
September	305	270	278	16,500	1.88	2.10
October	288	235	243	14,900	1.64	1.89
The period	....	....	....	229,000	....	....

NOTE.—The above values are fair.

WHITE RIVER AT MEEKER, COLO.

This station was established May 24, 1901. It is located about one-half mile above the town of Meeker, at a point where a wagon bridge crosses the stream, on the ranch of L. F. Van Cleave, in sec. 25, T. 1 N., R. 94 W. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 54, where are given also references to publications that contain data for previous years.

Discharge measurements of White River at Meeker, Colo., by A. A. Weiland, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 23	79	267	4.60	980	June 23	78	310	5.47	1,990
May 4	79	240	4.39	747	July 3	78	267	4.60	1,010
May 17	78	326	5.50	3,000	July 24	78	187	4.05	651
May 22	78	380	6.15	3,260	August 10	78	167	3.85	356
May 31	78	343	5.65	2,380	August 20	78	172	3.90	369
June 8	78	336	5.55	2,250					

Daily gage height, in feet, of White River at Meeker, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	3.80	4.28	5.55	5.00	3.92	3.75	3.80
2	3.68	4.25	5.68	4.92	3.95	3.82	3.80
3	3.65	4.22	5.65	4.82	3.90	3.95	3.78
4	3.65	4.35	5.68	4.78	3.88	3.80	3.75
5	3.65	4.80	5.80	4.68	3.90	3.80	3.80
6	3.68	4.90	6.05	4.58	3.90	3.75	3.78
7	3.88	4.82	5.82	4.68	3.88	3.70	3.78
8	3.78	5.00	5.52	4.62	3.85	3.70	3.78
9	3.82	5.22	5.58	4.58	3.85	3.70	3.70
10	3.90	5.40	5.72	4.52	3.85	3.70	3.70
11	3.98	5.60	5.92	4.55	3.80	3.70	3.70
12	3.92	5.62	6.10	4.48	3.82	3.62	3.68
13	3.78	5.30	6.25	4.42	3.90	3.62	3.68
14	3.72	5.20	6.38	4.58	4.02	3.72	3.65
15	3.82	5.20	6.30	4.45	3.92	4.05	3.65
16	3.92	5.52	6.25	4.38	3.85	4.08	3.65
17	4.08	5.65	6.28	4.32	3.92	3.92	3.65
18	4.20	5.72	6.08	4.30	3.98	3.92	3.65
19	4.05	5.90	5.90	4.22	3.88	3.90	3.65
20	4.15	6.08	5.85	4.20	3.85	3.92	3.70
21	4.25	6.02	5.78	4.12	3.85	3.92	3.70
22	4.40	6.12	5.72	4.10	3.88	3.90	3.70
23	4.55	6.10	5.68	4.05	3.82	3.90	3.68
24	4.72	5.92	5.50	4.02	3.82	3.85	3.58
25	4.52	5.80	5.28	4.00	3.75	3.82	3.70
26	4.45	5.70	5.22	4.00	3.72	3.82	3.72
27	4.30	5.65	5.25	3.95	3.70	3.92	3.72
28	4.30	5.95	5.18	3.92	3.70	3.88	3.72
29	4.28	6.22	5.05	3.90	3.70	3.82	3.70
30	4.30	5.85	5.05	3.88	3.70	3.80	3.70
31	....	5.60	....	3.85	3.72	....	3.70

Rating tables for White River at Meeker, Colo.

APRIL 1 TO JULY 31, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.70	435	4.30	770	4.90	1,295	5.50	2,090	6.00	2,970
3.80	485	4.40	840	5.00	1,405	5.60	2,250	6.10	3,160
3.90	535	4.50	920	5.10	1,525	5.70	2,420	6.20	3,350
4.00	590	4.60	1,000	5.20	1,655	5.80	2,600	6.30	3,550
4.10	645	4.70	1,090	5.30	1,795	5.90	2,780	6.40	3,750
4.20	705	4.80	1,190	5.40	1,940				

AUG. 9 TO OCT. 31, 1906.[b]

3.60	250	3.80	331	3.90	378	4.00	428	4.10	480
3.70	288	....	....	....	....	....	....	....	....

[a] This table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1906 and is well defined between gage heights 4 feet and 6.4 feet.

[b] This table is applicable only for open-channel conditions. It is based on 2 discharge measurements made during 1906 and the form of the preceding curve. From August 1 to 8, discharges were obtained by a transition between the tables.

Monthly discharge of White River at Meeker, Colo., for 1906.

[Drainage area, 634 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	1,120	410	628	37,400	0.991	1.11
May	3,390	718	2,100	129,000	3.31	3.82
June	3,710	1,460	2,530	151,000	3.99	4.45
July	1,400	510	836	51,400	1.32	1.52
August	500	288	371	22,800	.585	.67
September	470	258	345	20,500	.544	.61
October	331	243	292	18,000	.461	.53
The period				430,000		

NOTE.—The above values are good.

WHITE RIVER NEAR DRAGON, UTAH.

This station was established April 17, 1906. It is located at the toll bridge of the Uinta Stage Company, 18 miles northwest of Dragon, from which it is reached by stage.

The channel is straight for 400 feet above and below the station. The right bank is of shale, and high; the left bank is of earth and overflows at high water. The bed of the stream is composed of cobblestones and sand, somewhat shifting. There is one channel at all stages, broken by pile-bents, which somewhat disturb the current. The velocity of the current becomes very great at high stages.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is on the left bank, the hand-rail being graduated at 5-foot intervals.

A standard chain gage was installed May 14, 1906; length of chain, 22.65 feet. Prior to this date a staff gage was used having the same datum. The gages were read by J. B. Blankenship. The bench mark is a vertical standard Geological Survey iron post, set on the left bank about 75 feet downstream from the bridge; elevation, 23.85 feet above the datum of the gage.

Discharge measurements of White River near Dragon, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 17	R. I. Meeker	72	184	3.60	587
April 18	do	73	198	3.78	679
May 13	do	80	506	6.60	2,310
June 24	do	89	631	6.20	1,950
July 19	T. E. Brick	72	285	4.28	931

Daily gage height, in feet, of White River near Dragon, Utah, for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	4.00	4.85	6.75	5.12	3.50	3.85	3.50
2	3.90	4.82	6.55	5.12	3.80	3.88	3.58
3	3.80	4.65	6.60	5.00	3.75	3.95	3.55
4	3.70	4.48	6.58	4.92	3.68	4.20	3.50
5	3.60	4.48	6.42	4.80	3.65	3.85	3.52
6	3.60	4.80	6.52	4.65	3.58	3.65	3.55
7	3.60	5.35	6.78	4.65	3.50	3.55	3.60
8	3.60	5.45	6.88	5.40	3.50	3.52	3.50
9	3.60	5.55	6.30	4.68	3.50	3.50	3.45
10	3.60	5.95	6.12	4.62	3.40	3.42	3.48
11	3.60	6.38	6.38	4.52	3.32	3.40	3.45
12	3.60	6.10	6.50	4.50	3.30	3.38	3.45
13	3.60	6.70	6.68	4.50	3.40	3.35	3.40
14	3.60	6.30	7.00	4.48	4.20	3.30	3.40
15	3.60	6.00	7.20	4.62	3.75	3.70	3.40
16	3.60	5.80	7.35	4.60	3.68	5.15	3.45
17	3.60	6.02	7.38	4.42	3.90	5.20	3.40
18	3.75	6.30	7.40	4.32	3.80	4.15	3.38
19	4.30	6.45	7.52	4.30	4.65	3.95	3.35
20	4.40	6.62	7.32	4.22	4.25	3.80	3.40
21	4.05	6.70	6.60	4.15	3.65	3.72	3.40
22	4.25	7.00	6.45	4.05	3.75	3.80	3.42
23	4.55	7.05	6.32	3.98	3.60	3.75	3.45
34	4.70	7.22	6.25	3.90	3.58	3.68	3.42
25	4.95	7.90	6.10	3.85	3.48	3.65	3.42
26	4.95	7.00	5.75	3.75	3.40	3.60	3.45
27	4.90	6.75	5.58	3.70	3.38	4.10	3.48
28	4.90	6.50	5.55	3.68	3.30	3.95	3.45
29	4.70	6.92	5.45	3.75	3.35	3.80	3.40
30	4.65	7.25	5.38	3.55	3.32	3.72	3.45
31	....	7.42	....	3.45	3.42	....	3.48

Rating table for White River near Dragon, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	505	4.10	815	4.90	1,200	5.70	1,665	7.00	2,560
3.40	540	4.20	860	5.00	1,255	5.80	1,730	7.20	2,710
3.50	575	4.30	905	5.10	1,310	5.90	1,795	7.40	2,860
3.60	610	4.40	950	5.20	1,365	6.00	1,860	7.60	3,010
3.70	650	4.50	1,000	5.30	1,420	6.20	1,990	7.80	3,170
3.80	690	4.60	1,050	5.40	1,480	6.40	2,130		
3.90	730	4.70	1,100	5.50	1,540	6.60	2,270		
4.00	770	4.80	1,150	5.60	1,600	6.80	2,410		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and is fairly well defined. The high water of May caused a great change in area at the measuring section, but did not materially alter the relation of discharge to gage height.

Monthly discharge of White River near Dragon, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	1,230	610	804	47,800
May	3,250	990	2,000	123,000
June	2,950	1,470	2,230	133,000
July	1,480	558	949	58,400
August	1,080	505	627	38,600
September	1,360	505	707	42,100
October	610	522	560	34,400
The period				477,000

NOTE.—The above values are good.

MARVINE CREEK NEAR BUFORD, COLO.

This station was established July 27, 1903. It is located at a point where the stream is crossed by a large aspen log. The station is 10 miles from Buford, the nearest post-office, and is about 35 miles from Meeker. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 58, where are given also references to publications that contain data for previous years.

Discharge measurements of Marvine Creek near Buford, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 19	A. A. Weiland	28	45	2.30	201
June 5	do	28	48	2.37	230
June 25	do	28	43	2.50	258
July 6	do	28	46	2.36	245
July 19	do	28	38	2.25	148
August 5	do	28	36	2.10	129
August 28	do	28	38	2.15	137

Daily gage height, in feet, of Marvine Creek near Buford, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.95	2.32	2.40	2.18	2.20	2.18	2.10
2		1.95	2.35	2.38	2.18	2.22	2.18	2.10
3		2.00	2.35	2.32	2.18	2.25	2.18	2.10
4		2.05	2.35	2.32	2.18	2.18	2.18	2.10
5		2.10	2.38	2.32	2.18	2.18	2.18	
6		2.15	2.40	2.35	2.18	2.18	2.18	
7		2.18	2.30	2.38	2.18	2.18	2.18	
8		2.20	2.28	2.38	2.12	2.15	2.15	
9		2.22	2.32	2.32	2.12	2.15	2.15	
10		2.22	2.38	2.32	2.12	2.15	2.15	
11		2.22	2.42	2.28	2.12	2.15	2.15	
12		2.22	2.48	2.22	2.12	2.15	2.15	
13		2.20	2.52	2.15	2.12	2.15	2.15	
14		2.22	2.58	2.12	2.12	2.20	2.15	
15	1.90	2.30	2.68	2.10	2.12	2.22	2.15	
16	1.95	2.35	2.75	2.10	2.12	2.20	2.15	
17	1.95	2.35	2.70	2.10	2.18	2.20	2.15	
18	1.95	2.35	2.65	2.10	2.18	2.18	2.15	
19	1.95	2.35	2.65	2.10	2.15	2.15	2.15	
20	1.98	2.35	2.65	2.15	2.18	2.18	2.15	
21	1.98	2.38	2.55	2.22	2.18	2.18	2.12	
22	2.02	2.38	2.65	2.20	2.18	2.18	2.12	
23	2.10	2.30	2.65	2.22	2.18	2.18	2.12	
24	2.10	2.32	2.55	2.20	2.18	2.18	2.12	
25	2.02	2.28	2.50	2.18	2.18	2.18	2.12	
26	1.95	2.28	2.50	2.18	2.18	2.20	2.12	
27	1.95	2.32	2.55	2.18	2.18	2.18	2.12	
28	2.00	2.38	2.48	2.18	2.18	2.18	2.12	
29	1.98	2.35	2.45	2.18	2.18	2.18	2.10	
30	1.95	2.35	2.42	2.18	2.18	2.18	2.10	
31		2.35		2.20	2.20		2.10	

NOTE.—Gage heights for April somewhat uncertain; those for May 1 to 5 interpolated.

Rating table for Marrine Creek near Buford, Colo.

APRIL 19, 1905, TO JULY 12, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	74	2.00	126	2.30	205	2.50	269	2.70	339
1.80	89	2.10	150	2.40	235	2.60	304	2.80	377
1.90	106	2.20	177						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906 and is well defined between gage heights 1.8 feet and 2.5 feet. From July 13 to November 4, 1906, the following table was used: Gage height, 2.10 feet; discharge, 123 second-feet. Gage height, 2.20 feet; discharge, 146 second-feet. Gage height, 2.30 feet; discharge, 170 second-feet.

Monthly discharge of Marrine Creek near Buford, Colo., for 1906.

[Drainage area, 50 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec. ft. per sq. mile.	Depth in inches.
April 15-30	150	106	123	3,900	2.46	1.46
May	229	116	191	11,700	3.82	4.40
June	358	199	268	15,900	5.36	5.98
July	235	123	167	10,300	3.34	3.85
August	146	128	137	8,420	2.74	3.16
September	158	134	141	8,390	2.82	3.15
October	141	123	133	8,180	2.66	3.07
The period				66,800		

NOTE.—Values are rated as follows: April, and August to October, fair; May to July, good.

DUCHESNE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Duchesne River rises in the high peaks of the Uinta and Wasatch mountains, flows in a general southeasterly direction, and enters Green River 3 miles above the mouth of the White. It is a very crooked stream, swinging back and forth across its valley, its course marked by a thick line of cottonwoods.

The principal tributaries of the Duchesne are Strawberry, East, and Lake creeks and Uinta River. From the mouth of Strawberry Creek down to Lake Creek the valley of the Duchesne averages 2 miles in width and is bordered on both sides by sandstone bluffs approximately 200 feet high. The cliffs on the northern side of the river are capped by a heavy deposit of coarse river gravel and cobblestones.

Strawberry Creek, the main upper tributary of the Duchesne, drains an area of 1,166 square miles. The stream rises in the Uinta Mountains and the run-off is derived chiefly from melting snow except during the late summer, when the flow comes from small springs well distributed over the entire drainage basin. Numerous tributaries enter the stream, particularly from the north and west, Indian, Bryants Fork, Mud, Horse, Sugar Spring, and Co-op creeks being the principal ones. They are all short and fall rapidly until they reach the valley, through which they flow sluggishly in well-defined channels. The main stream traverses the valley from north to south and is very sluggish. Very little sediment is carried by the stream at any stage. The average elevation of Strawberry Valley is 7,500 feet, which is rather high for agricultural purposes but is excellently adapted to grazing. Indian Creek drains a small portion of the southern slopes of the Uinta Mountains. Its basin comprises smooth, rolling hills, fairly well timbered with pine and aspen. The normal flow is derived chiefly from springs. The greater part of the precipitation is in the form of snow, which covers the ground for six or eight months each year.

Uinta River and its principal tributary, Whiterocks River, have their sources in a series of lakes in the Uinta Mountains, fed by the snow that exists the year round in the canyons and on the high slopes. The upper drainage area of these streams is very mountainous and difficult of access. After leaving their canyons, 7 or 8 miles above the Indian agency at Whiterocks, the rivers flow southeastward, uniting in various channels between the agency and Fort Duchesne, from which point they flow in one channel, entering Duchesne River 6 miles below, near the Ouray Indian school. Pole, Farm, and Dry Gulch creeks are small tributaries of the Uinta.

DUCHESNE RIVER NEAR MYTON, UTAH.

This station, established originally October 26, 1899, was reopened April 1, 1906, in cooperation with the United States Indian Service. It was discontinued July 10, 1906. The gage was read by H. Calvert. The conditions at this station and the bench mark are described in Water-Supply Paper No. 133, page 113.

The following measurement was made May 9, 1906:

Width, 118 feet; area, 744 square feet; gage height, 7.60 feet; discharge, 2,760 second-feet.

Daily gage height, in feet, of Duchesne River near Myton, Utah, for 1906.

Day.	Apr.	May.	June.	July.	Day.	Apr.	May.	June.	July.
1	5.50	6.72	7.85	7.88	17	5.85	7.90	10.05	......
2	5.40	6.62	7.70	8.28	18	6.02	7.80	9.65	......
3	5.40	6.65	7.85	8.08	19	6.12	7.85	9.25	......
4	5.40	6.82	8.05	7.98	20	6.25	8.10	9.05	......
5	5.40	7.20	8.20	7.90	21	6.42	8.40	8.98	......
6	5.44	7.45	8.50	7.80	22	6.56	8.70	9.00	......
7	5.44	7.50	8.30	7.72	23	6.78	8.85	8.70	......
8	5.42	7.52	7.95	7.68	24	6.90	8.90	8.30	......
9	5.50	7.62	7.95	7.68	25	6.90	8.70	7.95	......
10	5.58	7.78	8.25	7.60	26	6.85	8.50	7.95	......
11	5.60	7.92	8.80	......	27	6.62	8.30	7.95	......
12	5.61	8.15	9.30	......	28	6.52	8.45	7.90	......
13	5.65	8.35	9.85	......	29	6.62	8.52	7.75	......
14	5.62	8.30	10.15	......	30	6.80	8.30	7.65	......
15	5.60	8.00	10.10	......	31	......	8.05	......	......
16	5.66	7.90	10.10	......					

Rating table for Duchesne River near Myton, Utah, for 1904 and 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.40	423	6.20	1,005	7.00	1,890	7.80	3,040	9.20	5,510
5.50	484	6.30	1,100	7.10	2,020	7.90	3,205	9.40	5,890
5.60	548	6.40	1,200	7.20	2,150	8.00	3,375	9.60	6,270
5.70	615	6.50	1,305	7.30	2,290	8.20	3,715	9.80	6,650
5.80	685	6.60	1,415	7.40	2,430	8.40	4,070	10.00	7,030
5.90	760	6.70	1,530	7.50	2,575	8.60	4,430	10.20	7,410
6.00	840	6.80	1,650	7.60	2,725	8.80	4,790		
6.10	920	6.90	1,770	7.70	2,880	9.00	5,150		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1904 and 1 during 1906, and is well defined.

Monthly discharge of Duchesne River near Myton, Utah, for 1906.

[Drainage area, 2,750 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	1,770	423	893	53,100	0.325	0.36
May	4,970	1,440	3,320	204,000	1.21	1.40
June	7,320	2,800	4,520	269,000	1.64	1.83
July 1-10	3,850	2,720	3,140	62,300	1.14	.42
The period				588,000		

NOTE.—The above values are excellent.

STRAWBERRY RIVER IN STRAWBERRY VALLEY, UTAH.

This station was established May 2, 1903, and discontinued July 12, 1906. It is located in the canyon about one-fourth mile above the junction of Strawberry and Indian creeks, and is somewhat inaccessible, the nearest settlement being Heber, 40 miles away. The chief object of the station is the determination of the amount of water available for storage in Strawberry Valley. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 61, where are given also references to publications that contain data for previous years.

Discharge measurements of Strawberry River in Strawberry Valley, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 7 [a]	A. B. Larson	23	38	2.13	36.1
January 10 [b]	do	22	37	2.15	31.7
January 13 [c]	do	21	38	2.25	33.7
January 15 [d]	do	21	25	1.61	13.7
January 16 [d]	do	21	27	1.89	18.6
January 18 [e]	do	20	36	2.65	25.8
January 22 [e]	do	20	35	2.50	22.8

[a] Ice 12 to 18 inches thick.

[b] Ice 15 inches thick.

[c] Ice 18 inches thick.

[d] Water backed by snow, ice 18 inches thick.

[e] Water over top of ice.

Discharge measurements of Strawberry River in Strawberry Valley, Utah, in 1906—Cont'd.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 12	H. S. Kleinschmidt	16	15	2.65	34.4
February 18	do	16	15	2.70	30.4
March 10[a]	do	16	14	3.25	21.0
March 21[b]	do	16	16	3.50	19.0
April 13	H. W. Sheley	20	20	3.45	18.0
April 15	A. B. Larson	35	86	3.45	131
April 19	do	49	132	4.05	285
April 20	do	52	123	3.64	345
April 21[c]	do	58	168	3.55	470
April 22	do	59	211	4.15	637
April 23	do	58	190	3.86	552
April 27	do	58	144	3.12	365
April 29	do	59	222	4.34	694
May 3	do	62	270	4.93	874
May 4	do	63	297	5.32	984
May 7	do	61	250	4.70	783
June 18	do	60	160	2.65	241
July 12	Thos. Grieve	60	74	1.98	106

[a] Six inches of water over ice. [b] One inch of water over ice. [c] Channel clear of ice.

Daily gage height, in feet, of Strawberry River in Strawberry Valley, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1		2.54		3.60	3.81	3.48	2.11	17	2.50	2.68	3.20	3.32	4.13	2.80
2		2.53		3.50	4.02	3.48	2.05	18	2.65	2.70	3.28	3.28	4.12	2.68
3		2.53		3.45	4.60	3.52		19	2.57	2.70	3.35	4.13	4.26	2.62
4		2.55		3.40	5.15	3.57	2.05	20	2.60		3.40	3.53	4.51	2.58
5		2.55			5.30	3.70		21	2.49		3.50	3.48	4.66	2.50
6		2.55			4.94	3.74	2.00	22	2.50		3.55	3.77	4.61	2.42
7	2.13	2.59			4.62	3.42		23	2.53		3.59	3.94	4.52	2.38
8	2.14	2.60			4.58	3.18	1.95	24	2.59			4.14	4.49	
9	2.07	2.62	3.22		4.61	3.05		25	2.60			4.04	4.37	2.30
10	2.15	2.63	3.25		4.56	3.12	1.95	26	2.59			3.39	4.07	2.20
11	2.18	2.66			4.56	3.15		27	2.56			3.37	4.24	
12	2.22	2.65	3.25		4.97	3.18	1.90	28	2.57			3.85	4.50	
13	2.25	2.63	3.31		5.34	3.22		29	2.54			4.26	4.52	2.28
14	1.98	2.63		2.95	4.83	3.18		30	2.53			3.89	4.12	2.18
15	1.61	2.64	3.28	3.34	4.18	2.98		31	2.53		3.70		3.72	
16	1.89	2.70	3.17	3.38	4.18	2.91								

NOTE.—Ice conditions prevailed from January 1 to April 20, 1906; during this period the gage was read to water surface through a hole in the ice. The following comparative readings were made:

Comparative ice and water readings.

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 9	2.07	2.25	1.3 to 1.7	January 17	2.5	2.5	1.5
January 12-13			1.5	January 21-30	([a])		1.6
January 14	1.98	2.4	1.4	February 1	2.54	2.7	1.7
January 15	1.61	2.5	1.5	February 12-19			1.8
January 16	1.89	2.6	1.5	March 9			2.0

[a] Water surface 1 inch below top of ice.

From March 9 to 19, there was about 0.5 foot of water and slush on top of ice, this condition having probably existed from about February 25; on March 22 this thickness was 0.8 foot. April 17 and 18 the ice was clearing away, and formed a gorge below the gage April 19; creek clear of ice April 20.

Rating table for Strawberry River in Strawberry Valley, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	92	2.50	207	3.10	351	3.70	511	4.60	770
2.00	109	2.60	229	3.20	377	3.80	539	4.80	830
2.10	127	2.70	252	3.30	403	3.90	567	5.00	892
2.20	146	2.80	276	3.40	430	4.00	595	5.20	954
2.30	166	2.90	300	3.50	457	4.20	652	5.40	1,017
2.40	186	3.00	325	3.60	484	4.40	710		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 13 discharge measurements made during 1905–6, and is well defined.

Monthly discharge of Strawberry River in Strawberry Valley, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	36	14	28.0	1,720
February	34	25	30.0	1,670
March	24	19	20.4	1,250
April	669	18	228	13,600
May	998	517	738	45,400
June	522	142	307	18,100
July 1-12	129	92	108	2,570
The period				84,300

NOTE.—Values are rated as follows: January to April, good; May to July, excellent.

INDIAN CREEK IN STRAWBERRY VALLEY, UTAH.

This station was established April 5, 1905, and was discontinued July 12, 1906. It is located in the canyon about 250 feet above the junction of the creek with Strawberry Creek. It is about 1 mile below the point where Indian Creek leaves Indian Creek Valley and enters the canyon, and is 40 miles from Heber, the nearest post-office. The records will show the amount of water that can be diverted from Indian Creek into the Strawberry Valley storage reservoir. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 64.

Discharge measurements of Indian Creek in Strawberry Valley, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Thickness of ice.	Gage height.	Discharg
		Feet.	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft*
January 7	A. B. Larson	14	19	1.5-2.1	1.35	11.2
January 10	do	14	18	1.6	1.30	10.9
January 15	do	14	14	1.7	1.12	7.6
January 16	do	14	13		1.09	7.7
January 26	do	14	12	1.75	1.00	6.7
February 2	do	13	12	1.9	1.01	7.8
February 13	H. S. Kleinschmidt	12	6		1.31	12.2
February 18	do	14	7		1.30	12.4
March 12	do	14	7		1.17	8.4
April 4	H. W. Sheley	14	18		1.10	16.8
April 15	A. B. Larson	14	32	1.0-1.7	2.54	29.5
April 18	do	16	36	0.8-1.5	2.62	51.4
April 20	do	16	31		2.06	43.5
April 21	do	16	29	([a])	1.50	51.3
April 22	do	16	37		1.87	88
April 24	do	16	43		2.15	112
April 27	do	16	24		1.39	42.3
April 28	do	16	31		1.77	83
April 28	do	16	40		2.11	123
May 2	do	16	46		2.55	182
May 3	do	16	43		2.40	156
May 3	do	22	59		2.72	168
May 7	do	20	54		2.58	166
May 12	do	22	68		3.13	247
May 14	do	22	64		2.82	206
May 14	do	22	58		2.70	202
May 15	do	16	45		2.55	182
May 26	do	16	40		2.25	142
July 12	Thos. Grieve	16	17		1.30	37.7

[a] Channel clear of ice.

Daily gage height, in feet, of Indian Creek in Strawberry Valley, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1		0.95		1.45	1.73	1.90	1.35	17	1.06	1.30	0.98	3.04	2.54	1.45
2		1.01	[a]	1.30	2.10	1.90	1.35	18	1.04	1.30	.97	2.83	2.55	1.48
3		1.00		1.30	2.33	1.84		19	1.05	1.27	.97	2.47	2.54	1.48
4		1.02		1.10	[b]2.72	1.80	1.35	20	1.04	([a])	.98	1.98	2.63	1.48
5		1.05			[b]2.80	1.82		21	1.09		.98	1.42	2.66	1.42
6		1.05			[b]2.55	1.88	1.3	22	1.03		.98	1.59	2.65	1.40
7	1.35	1.10			2.50	1.72		23	1.02		1.00	1.78	2.54	1.40
8	1.34	1.15			2.55	1.60	1.30	24	1.01			1.94	2.51	
9	1.14	1.20			2.65	1.60		25	1.00			1.84	2.41	1.40
10	1.30	1.25	1.00		2.63	1.62	1.25	26	1.00			1.49	2.24	1.40
11	1.32	1.30			2.64	1.58		27	.99			1.60	2.28	
12	1.45	1.31	1.00		2.99	1.52	1.30	28	.99			1.83	2.48	
13	1.57	1.31	1.00	3.70	3.15	1.55		29	.96			2.06	2.35	1.40
14	1.08	1.31		2.48	2.77	1.52		30	.95			1.86	2.18	1.35
15	1.12	1.31		2.69	2.51	1.52		31	.95		1.57		1.95	
16	1.09	1.35	.98	2.91	2.55	1.50								

[a] Gage height fell uniformly February 20 to March 8.

[b] Backwater from Strawberry River.

Comparative ice and water readings.

NOTE.—Ice conditions prevailed from January 1 to April 20, 1906; during this period the gage was read to water surface through a hole in the ice. The following comparative readings were made:

Date.	Water surface.	Top of ice.	Thickness of ice.	Date.	Water surface.	Top of ice.	Thickness of ice.
	Feet.	*Feet.*	*Feet.*		*Feet.*	*Feet.*	*Feet.*
January 8	1.34	2.4	1.5-2.0	January 16	1.09	2.5	
January 9	1.14	2.4		January 17-18	[a]1.06	2.5	
January 10	1.30	2.4		February 1	.95	2.6	1.9
January 11	1.32	2.4		February 12-19			2.1
January 14	1.08	2.6	1.6	March 9			2.3
January 15	1.12	2.4		April 4			3.0

[a] Approximate.

Water 0.3 to 0.7 foot over top of ice April 13 to 20.

Rating table for Indian Creek in Strawberry Valley, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.3	36	1.7	72	2.1	117	2.5	167	2.9	222
1.4	44	1.8	83	2.2	129	2.6	180	3.0	236
1.5	53	1.9	94	2.3	141	2.7	194	3.1	250
1.6	62	2.0	105	2.4	154	2.8	208		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined.

Monthly discharge of Indian Creek in Strawberry Valley, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	12	7	9.1	560
February	12	8	10.5	583
March	10	8	8.4	516
April	112	15	44.9	2,670
May	257	75	165.0	10,100
June	94	40	59.0	3,510
July (1-12)	40	32	36.8	876
The period				18,800

NOTE.—Values are rated as follows: January to April, good; May to July, excellent.

UINTA RIVER AT FORT DUCHESNE, UTAH.

This station, established originally September 14, 1899, was reopened April 21, 1906, in cooperation with the United States Indian Service. On June 13, the bridge and gage were washed away, and the station was abandoned. The gage was read during 1906 by Bert Marsing. The conditions at this station and the bench marks are described in Water-Supply Paper No. 133, page 106.

Discharge measurements of Uinta River at Fort Duchesne, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 21	R. I. Meeker	52	185	3.08	256
May 8	E. O. Greene	59	230	3.70	484

Daily gage height, in feet, of Uinta River at Fort Duchesne, for 1906.

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1		3.05	4.45	17		4.1	
2		3.05	4.35	18		4.05	
3		3.05	4.55	19		4.25	
4		3.1	4.85	20		4.65	
5		3.25	5.45	21	3.05	5.15	
6		3.5	5.5	22	3.25	5.6	
7		3.45	5.2	23	3.4	5.75	
8		3.55	5.1	24	3.3	5.85	
9		3.75	5.45	25	3.3	5.25	
10		4.0	5.75	26	3.25	4.85	
11		4.25	6.75	27	3.15	4.6	
12		4.55	6.8	28	3.0	5.0	
13		4.75	7.0	29	3.15	4.95	
14		4.3		30	3.15	4.6	
15		4.4		31		4.45	
16		4.1					

PRICE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Price River rises in the Wasatch Mountains, in the southeastern part of Utah County, flows in a general southeasterly direction, and unites with Green River at a point about 14 miles above Greenriver, Utah. The main source of supply is the snow in the upper reaches of the basin, where elevations range from 8,000 to 9,000 feet. The region is extremely rough and rugged. The principal rock is a loose and badly disintegrated sandstone. There is but little soil and practically no vegetation except for small groves of scrubby cedar and a few scattered pines. The original scanty underbrush and grass have been almost entirely tramped out by sheep and cattle. The river is subject to floods in the spring and early summer, during which time it carries immense quantities of sediment. Gordon and Pleasant creeks are the main tributaries. They are both short, steep streams and enter the river from the west almost at right angles.

PRICE RIVER NEAR HELPER, UTAH.

This station was established February 21, 1904. It is located on the upper side of the ford near the settlement of Spring Glen, about 3 miles south of Helper, Utah, and 350 feet west of the main line of the Denver and Rio Grande Railroad.

During 1906 a cable and car were installed, from which high-water measurements are made. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 67, where are given also references to publications that contain data for previous years.

Discharge measurements of Price River near Helper, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	H. S. Kleinschmidt	54	134	4.70	449
May 18	Thos. Greve	66	216	5.70	1,220
May 31	do	64	195	5.50	870
June 30	do	59	106	4.20	187
October 18	do	42	102	3.35	30.2

Daily gage height, in feet, of Price River near Helper, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	3.2	3.2	4.0	4.5	5.2	4.1	4.0	3.6	3.4	3.6	3.3
2	3.1	3.2	3.3	3.8	4.4	5.2	4.1	4.5	3.6	3.4	3.5	3.3
3	3.1	3.3	3.2	3.6	4.5	5.2	4.1	4.0	3.6	3.4	3.5	3.3
4	3.1	3.3	3.2	3.8	4.6	5.2	4.0	4.0	3.5	3.4	3.4	3.3
5	3.1	3.3	3.2	3.6	5.0	5.2	4.0	4.0	3.5	3.4	3.4	3.3
6	3.1	3.3	3.3	3.6	5.2	5.1	4.0	4.0	3.5	3.4	3.4	3.3
7	3.1	3.3	3.3	4.0	5.2	5.1	4.0	3.9	3.5	3.4	3.4	3.3
8	3.2	3.3	3.3	4.0	5.2	4.0	4.0	3.9	3.4	3.4	3.4	3.3
9	3.2	3.3	3.3	4.2	5.3	4.0	4.0	3.8	3.4	3.4	3.4	3.4
10	3.2	3.3	3.4	4.2	5.4	4.9	4.0	3.8	3.4	3.4	3.4	3.3
11	3.1	3.3	3.3	4.2	5.5	4.9	3.9	3.8	3.4	3.4	3.4	3.3
12	3.1	3.3	3.3	4.2	5.8	4.9	3.9	3.8	3.4	3.4	3.4	3.3
13	3.1	3.3	3.3	4.1	5.8	4.9	3.9	3.8	3.4	3.4	3.4	3.3
14	3.1	3.3	3.3	4.1	5.6	4.9	3.9	4.2	3.4	3.4	3.4	3.3
15	3.1	3.3	3.3	4.3	5.5	4.8	3.9	3.9	3.5	3.4	3.4	3.3
16	3.1	3.3	3.2	4.4	5.5	4.8	3.9	3.9	3.6	3.4	3.4	3.3
17	3.1	3.3	3.2	4.6	5.7	4.7	3.9	3.9	3.6	3.4	3.4	3.3
18	3.1	3.3	3.2	4.7	5.7	4.6	4.7	3.8	3.6	3.4	3.4	3.3
19	3.1	3.3	3.1	4.6	5.7	4.6	5.9	3.8	3.5	3.4	3.4	3.3
20	3.1	3.4	3.3	4.6	6.0	4.5	4.0	3.8	3.5	3.4	3.3	3.3
21	3.2	3.3	3.2	4.7	6.3	4.5	3.7	3.9	3.5	3.4	3.3	3.3
22	3.2	3.3	3.3	4.7	6.3	4.4	3.7	3.9	3.5	3.4	3.3	3.3
23	3.1	3.2	3.3	4.8	6.2	4.4	3.7	3.7	3.5	3.4	3.3	3.3
24	3.1	3.2	3.6	4.9	6.2	4.3	4.8	3.7	3.5	3.4	3.3	3.4
25	3.2	3.2	3.7	4.8	5.8	4.3	3.9	3.6	3.5	3.4	3.3	3.4
26	3.2	3.2	3.7	4.7	5.6	4.3	3.9	3.6	3.5	3.4	3.3	3.4
27	3.3	3.3	3.6	4.6	5.6	4.2	3.8	3.6	3.4	3.4	3.3	3.3
28	3.3	3.3	3.8	4.5	5.6	4.2	3.8	3.6	3.4	3.4	3.3	3.3
29	3.3	......	4.1	4.5	5.6	4.2	4.0	3.5	3.4	3.4	3.3	3.3
30	3.3	......	4.0	4.5	5.5	4.1	4.0	3.5	3.4	3.4	3.3	3.3
31	3.2	......	4.0	......	5.3	......	4.0	3.5	...	3.4	.....	3.3

Rating table for Price River near Helper, Utah, for 1905-6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	1	3.60	60	4.20	219	4.80	508	5.80	1,145
3.10	4	3.70	78	4.30	260	4.90	563	6.00	1,295
3.20	9	3.80	98	4.40	305	5.00	620	6.20	1,450
3.30	18	3.90	122	4.50	354	5.20	740		
3.40	30	4.00	150	4.60	404	5.40	870		
3.50	44	4.10	182	4.70	455	5.60	1,005		

NOTE.- The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906 and is well defined.

Monthly discharge of Price River near Helper, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	18	4	7.1	437
February	30	9	16.5	916
March	182	4	38.6	2,370
April	563	60	290	17,300
May	1,530	305	949	58,400
June	740	150	446	26,500
July	1,220	78	191	11,700
August	354	44	113	6,950
September	60	30	42.0	2,510
October	30	30	30.0	1,840
November	60	18	27.5	1,640
December	30	18	19.5	1,200
The year	1,530	4	181	132,000

NOTE.—Values are rated as follows: April to June, good; July and August, fair; remainder of 1906, approximate.

GRAND RIVER DRAINAGE BASIN.

AREA AND EXTENT.

Grand River and its tributaries drain an area comprising approximately 26,180 square miles, of which 22,290 are in Colorado and the rest in eastern Utah. On the east and southeast the basin is limited by the high ranges of the Continental Divide, which separate it from the basins of Platte and the Arkansas rivers; on the north by the White River and Book Cliffs plateaus; on the west by the canyon district of the Colorado.

The tributaries include innumerable small creeks and five large streams—Blue, Eagle, Roaring Fork, Gunnison, and Dolores rivers.

The main river is described first and the tributaries afterwards in their order, from the head down.

GRAND RIVER.

DESCRIPTION OF BASIN.

Grand River rises on the western slopes of the Rocky Mountains among the high peaks of the Front Range, flows in a general southwesterly direction across Colorado into Utah, and unites with Green River to form the Colorado. From source to mouth the total distance traversed is about 350 miles.

In most respects the Grand is a typical mountain stream, flowing throughout its course in a succession of deep canyons, with precipitous and ofttimes perpendicular walls varying in height up to 3,000 feet above the water's edge, alternating with long, narrow, fertile valleys.

The headwater region, comprising approximately 50 per cent of the basin, consists of a long stretch of the western portion of the

Continental Divide, extending from the north-central portion of Colorado southward nearly to the Colorado-New Mexico line, a distance of 260 miles, and separating the waters of the Grand from those of the Platte and Arkansas basins. The area is extremely rugged, elevations ranging from 7,000 to 14,000 feet. Gradients are steep, stream channels are numerous, and tributaries are rapid, the fall varying from 20 to 150 feet. The streams of this region derive their waters chiefly from the snow masses on the Continental Divide and furnish the perennial discharge of the Grand. The intermediate or middle portion of the basin, consisting largely of broken and scoured plateaus of sedimentary origin, contributes a relatively small amount of the run-off, the tributaries being few, and, with the exception of Gunnison River, insignificant. The lower portion of the basin, immediately adjacent to the Colorado-Utah State line, is an arid, much eroded region, furnishing an appreciable run-off, which carries a large amount of sediment.

The largest tributaries of the headwater region are Frazer, Williams Fork, Troublesome, Blue, and Muddy rivers, which add their waters to the Grand before it leaves Middle Park. Eagle River comes in near Eagle, just above the point where the river enters Grand River Canyon, and Roaring Fork unites with it just below the mouth of the canyon at Glenwood Springs. At Grand Junction, Colo., the river receives the waters of its largest tributary, Gunnison River, and thereafter no other stream of importance enters until the Dolores comes in, 15 miles west of the Utah boundary.

A peculiar feature of the drainage is what might be termed its one-sided nature, practically all its important tributaries entering the river from the east. That part of the basin lying north and west of the Grand is much less extensive in area, is lower, and is generally broken and barren, and a considerable portion of the waters of its streams is diverted for irrigation.

The mountainous portion of the basin is still well covered with forests of spruce, quaking aspen, cedar, and piñon, and the forestation of the intermediate basin is fair. The controlling vegetation of the lower basin is sagebrush, chico, and cactus pads, with scattered pines, cedars, and piñons.

The precipitation ranges from 5 to 10 inches in the lower basin, 10 to 20 inches in the intermediate region, and 20 to 30 inches in the headwater region. By far the greater part of this is in the form of snow.

Natural storage within the basin is limited to a few small, high, mountain lakes. The stream channels of the upper basin are bordered to some extent by flat bottom lands, which are used as meadows and which are irrigated by a large number of small ditches. In the intermediate basin are a few small reservoirs storing snow and flood waters. A number of pumping plants also draw upon this district.

Irrigation is extensively practiced in the Uncompahgre, Gunnison, and Grand valleys, and a large project now under construction by the Reclamation Service will require 1,200 second-feet of the discharge of Gunnison River. The immense power possibilities of the Grand are at present but little developed.

NORTH FORK OF GRAND RIVER NEAR GRAND LAKE, COLO.

This station was established July 29, 1904. It is located at the highway bridge between Grand Lake and Hot Sulphur Springs, Colo., about 3 miles southwest of Grandlake post-office, in T. 3 N., R. 76 W. The nearest railroad station is at Granby, on the Denver, Northwestern and Pacific, 15 miles distant. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 70, where are given also references to publications that contain data for previous years.

Discharge measurements of North Fork of Grand River near Grandlake, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	M. C. Hinderlider	52	126	4.87	459
June 14	do	54	175	6.00	1,100
June 29	T. E. Brick	49	109	4.70	397
September 10	A. A. Weiland	40	57	3.59	45
December 16	R. I. Meeker	31	66	(a)	37

[a] Gage height affected by ice.

Daily gage height, in feet, of North Fork of Grand River near Grandlake, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.30	3.98	4.70	4.90	4.05	3.70	3.90	3.70	3.50
2	3.30	3.92	4.82	4.88	4.05	3.70	3.92	3.68	3.50
3	3.30	4.05	4.82	4.75	4.02	3.78	3.88	3.65	3.50
4	3.30	4.15	4.88	4.62	4.00	3.75	3.82	3.65	3.50
5	3.35	4.22	4.98	4.55	4.10	3.72	3.82	3.62	3.48
6	3.40	4.40	5.18	4.50	4.02	3.68	3.82	3.60	3.45
7	3.38	4.35	4.95	4.50	4.00	3.62	3.80	3.58	3.50
8	3.35	4.38	4.68	4.58	3.95	3.60	3.80	3.55	3.50
9	3.35	4.52	4.90	4.55	3.82	3.60	3.78	3.58	3.50
10	3.35	4.70	5.12	4.52	3.80	3.60	3.75	3.60	3.50
11	3.42	4.72	5.52	4.58	3.82	3.60	3.70	3.60	3.50
12	3.45	4.70	5.82	4.60	3.85	3.60	3.70	3.60	3.48
13	3.50	4.62	5.90	4.52	4.00	3.60	3.70	3.60	3.48
14	3.50	4.50	5.90	4.68	4.18	3.60	3.65	3.60	3.48
15	3.52	4.50	5.85	4.65	3.98	3.62	3.65	3.60	3.48
16	3.60	4.72	5.85	4.58	3.90	4.00	3.60	3.55	3.45
17	3.65	4.88	5.88	4.52	3.85	3.85	3.60	3.52	3.40
18	3.65	4.88	5.75	4.48	3.85	3.80	3.60	3.52	3.42
19	3.70	5.00	5.30	4.40	3.88	3.85	3.58	3.52	3.45
20	3.78	5.20	5.02	4.30	3.85	3.95	3.55	3.50	3.40
21	4.02	5.18	4.92	4.30	3.88	4.00	3.60	3.50	3.40
22	4.28	5.18	4.92	4.30	3.88	3.92	3.60	3.50	3.40
23	4.30	5.15	5.00	4.28	3.85	4.00	3.60	3.50	3.40
24	4.22	5.08	4.88	4.25	3.80	4.00	3.60	3.50	3.40
25	4.22	4.95	4.75	4.28	3.80	4.00	3.60	3.50	3.42
26	4.10	4.78	4.75	4.18	3.80	4.02	3.62	3.50	3.40
27	3.95	4.75	4.82	4.12	3.80	4.02	3.68	3.50	3.40
28	4.05	4.95	4.98	4.05	3.75	4.00	3.68	3.50	3.40
29	4.02	5.20	4.78	4.05	3.75	3.98	3.62	3.50	3.40
30	4.08	4.90	4.88	4.05	3.72	3.92	3.70	3.50	3.40
31		4.75		4.00	3.70		3.70		3.40

NOTE.—There was backwater from ice during a portion of November and December; gage heights have been corrected.

Rating table for North Fork of Grand River near Grandlake, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	20	3.90	99	4.50	298	5.10	570	5.70	910
3.40	26	4.00	123	4.60	339	5.20	625	5.80	970
3.50	35	4.10	152	4.70	382	5.30	680	5.90	1,030
3.60	47	4.20	185	4.80	426	5.40	735		
3.70	62	4.30	221	4.90	472	5.50	790		
3.80	79	4.40	259	5.00	520	5.60	850		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and the form of the 1905 curve. It is well defined above gage height 3.5 feet.

Monthly discharge of North Fork of Grand River near Grandlake, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	221	20	76.8	4,570
May	625	104	388	23,900
June	1,030	373	612	36,400
July	472	123	278	17,100
August	178	62	101	6,210
September	129	47	83.8	4,990
October	104	41	62.9	3,870
November	62	35	42.5	2,530
December	35	26	30.3	1,860
The period				101,000

NOTE.—Values are rated as follows: May to July, excellent; remainder of 1906, good.

GRAND LAKE OUTLET AT GRANDLAKE, COLO.

This station was established July 31, 1904. It is located at the footbridge at the west end of Grand Lake, about one-half mile south of Grandlake post-office, Colo., in sec. 6, T. 3 N., R. 75 W. The nearest railroad station is 18 miles distant, at Granby, on the Denver, Northwestern and Pacific Railway. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 72, where are given also references to publications that contain data for previous years.

Discharge measurements of Grand Lake Outlet, at Grandlake, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 18	M. C. Hinderlider	109	212	2.80	357
June 15	do	170	444	4.30	1,110
June 29	T. E. Brick	120	204	3.15	472
September 11	A. A. Weiland	110	75	1.80	47
December 16	R. I. Meeker	47	50	1.40	11

Daily gage height, in feet, of Grand Lake Outlet at Grandlake, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.15	1.98	2.82	3.50	2.35	1.75	2.10	1.70	1.45
2	1.20	1.92	2.90	3.48	2.35	1.88	2.05	1.70	1.40
3	1.18	1.90	2.95	3.35	2.35	2.05	2.00	1.70	1.40
4	1.20	1.85	2.92	3.18	2.30	2.05	2.00	1.70	1.42
5	1.20	1.90	3.10	3.20	2.30	2.02	1.98	1.68	1.45
6	1.22	1.95	3.45	3.05	2.25	1.98	1.95	1.65	1.45
7	1.30	2.02	3.20	2.98	2.25	1.95	1.90	1.65	1.45
8	1.32	2.02	2.92	2.90	2.22	1.90	1.90	1.62	1.45
9	1.32	2.12	2.95	2.92	2.20	1.85	1.88	1.60	1.45
10	1.38	2.30	3.30	2.95	2.15	1.80	1.85	1.60	1.45
11	1.40	2.48	3.78	3.02	2.10	1.80	1.85	1.60	1.45
12	1.45	2.58	4.00	3.10	2.10	1.75	1.82	1.58	1.42
13	1.48	2.62	4.28	3.22	2.10	1.75	1.80	1.55	1.40
14	1.50	2.52	4.27	3.35	2.10	1.72	1.75	1.58	1.40
15	1.52	2.42	4.15	3.30	2.10	1.70	1.75	1.55	1.40
16	1.55	2.52	4.28	3.15	2.05	1.88	1.75	1.55	1.40
17	1.58	2.65	4.22	3.00	2.05	1.90	1.72	1.55	1.38
18	1.68	2.80	3.65	2.92	2.00	1.90	1.70	1.55	1.35
19	1.72	2.98	3.48	2.82	2.00	1.95	1.70	1.52	1.35
20	1.75	3.20	3.40	2.78	2.00	1.95	1.70	1.50	1.35
21	1.82	3.25	3.40	2.78	2.00	2.00	1.68	1.45	1.35
22	1.92	3.38	3.32	2.72	2.10	2.05	1.65	1.45	1.35
23	2.02	3.48	3.40	2.72	2.12	2.10	1.65	1.45	1.35
24	2.18	3.35	3.20	2.75	2.08	2.10	1.65	1.45	1.35
25	2.20	3.12	2.98	2.78	2.05	2.08	1.65	1.45	1.35
26	2.15	2.88	2.88	2.68	1.98	2.08	1.65	1.45	1.35
27	2.08	2.82	3.10	2.58	1.90	2.25	1.65	1.45	1.38
28	2.02	2.92	3.22	2.50	1.85	2.25	1.65	1.45	1.40
29	2.00	3.22	3.18	2.48	1.82	2.20	1.70	1.45	1.40
30	2.00	3.15	3.32	2.42	1.80	2.18	1.70	1.45	1.40
31	....	2.92	....	2.35	1.75	....	1.70	....	1.40

NOTE.—From May 27 to June 14, the gage heights were affected by an obstruction of logs at the outlet of the lake; they have been corrected, but are still liable to slight error.

Rating table for Grand Lake Outlet at Grandlake, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.15	3	1.80	47	2.50	224	3.20	515	3.90	890
1.20	4	1.90	64	2.60	260	3.30	565	4.00	945
1.30	7	2.00	84	2.70	298	3.40	615	4.10	1,000
1.40	11	2.10	106	2.80	338	3.50	670	4.20	1,055
1.50	16	2.20	131	2.90	379	3.60	725	4.30	1,110
1.60	23	2.30	159	3.00	420	3.70	780		
1.70	33	2.40	190	3.10	465	3.80	835		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and is well defined.

Monthly discharge of Grand Lake Outlet at Grandlake, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	131	3	40.6	2,420
May	650	56	296	18,200
June	1,100	346	628	37,400
July	670	174	402	24,700
August	174	40	107	6,580
September	145	33	79.2	4,710
October	106	28	48.5	2,980
November	33	14	21.0	1,250
December	14	9	11.2	689
The period				98,900

NOTE.—Values are rated as follows: May, July and August, excellent; remainder of 1906, good.

NORTH INLET TO GRAND LAKE AT GRANDLAKE, COLO.

This station was established August 3, 1905, and was discontinued July 22, 1906. It is located at the footbridge which crosses the stream about 100 yards north and 300 yards east of Grandlake post-office in sec. 5, T. 3 N., R. 75 W.

The conditions at this station and the bench marks are described in Water-Supply Paper 175, page 75.

Discharge measurements of North Inlet to Grand Lake at Grandlake, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 17	M. C. Hinderlider	49	88	2.95	223
June 14	do	59	162	4.00	644
June 29	T. E. Brick	49	88	3.10	243
September 10	A. A. Weiland	47	39	2.12	28
December 15	R. I. Meeker	8	7.4	....	8

Daily gage height, in feet, of North Inlet to Grand Lake at Grandlake, Colo., for 1906.

Day.	May.	June.	July.	Day.	May.	June.	July.
1	....	3.10	3.24	17	2.70	3.72	2.97
2	....	3.05	3.24	18	2.85	3.64	2.90
3	2.25	3.10	3.20	19	2.95	3.34	2.82
4	2.35	3.12	3.20	20	3.00	3.24	2.77
5	2.48	3.02	3.20	21	3.05	3.22	2.72
6	2.55	2.98	3.16	22	3.20	3.20	2.72
7	2.45	2.95	3.16	23	3.25	3.20	....
8	2.55	2.88	3.12	24	3.20	3.14	....
9	2.72	3.08	3.14	25	3.10	3.14	....
10	2.82	3.50	3.20	26	3.02	3.10	....
11	2.90	3.75	3.22	27	3.08	3.10	....
12	2.82	3.90	3.17	28	2.98	3.04	....
13	2.78	4.00	3.12	29	3.00	3.04	....
14	2.72	4.00	3.04	30	3.05	3.04	....
15	2.68	3.74	3.04	31	3.05	....	....
16	2.75	3.74	3.04				

GRAND RIVER AT HOT SULPHUR SPRINGS, COLO.

This station was established July 27, 1904. It was located at the highway bridge one-eighth mile below Hot Sulphur Springs, Colo., in sec. 3, T. 1 N., R. 78 W., and is 5 miles above the mouth of Williams Fork River.

On April 16, 1906, the station was removed to a new highway bridge, about 1,000 feet above the old station, where conditions are much more favorable for measurements.

On May 22, a standard wire gage was installed; length of chain, 19.17 feet. The bench mark is a cross cut in the west face of a foundation stone near the southwest corner of the Riverside Bar and Café building, near the east end of the bridge; elevation, 20.04 feet above the datum of the gage.

Discharge measurements of Grand River at Hot Sulphur Springs, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.		Discharge.
				Old gage.	New gage.	
		Feet.	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
April 14	M. C. Hinderlider	88	97	3.55	1.65	224
April 16	do	98	150	4.10	2.25	520
May 19	do	137	424	7.20	4.40	3,240
May 22	do	148	507	7.85	5.24	3,920
June 16	do	310	831	9.35	6.06	5,360
June 30	T. E. Brick	133	403	6.50	4.12	2,320
September 9	A. A. Weiland	98	148	....	1.82	286
December 14	R. I. Meeker	92	159	....	(a)	175

[a] Gage height affected by ice 0.5 to 1.0 foot thick.

Daily gage height, in feet, of Grand River at Hot Sulphur Springs, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	4.22	2.45	4.05	4.30	2.55	1.90	2.20	1.70
2	4.18	2.45	4.15	4.25	2.60	2.25	2.20	1.70
3	3.98	2.45	4.25	4.05	2.48	2.25	2.15	1.70
4	4.38	2.80	4.10	3.85	2.45	2.15	2.15	1.70
5	4.55	2.95	4.30	3.75	2.45	2.00	2.15	1.70
6	4.60	3.10	4.85	3.65	2.40	1.95	2.10	1.70
7	4.50	3.00	4.40	3.60	2.40	1.92	2.08	1.70
8	4.10	3.30	4.10	3.65	2.30	1.85	2.00	1.70
9	4.22	3.40	4.00	3.68	2.20	1.80	2.00	1.72
10	4.40	3.55	4.05	3.65	2.20	1.80	2.00	1.78
11	4.55	3.55	4.85	3.65	2.10	1.80	2.00	1.82
12	4.25	3.40	5.50	3.62	2.10	1.70	2.00	1.78
13	3.90	3.75	6.05	3.70	2.15	1.72	2.00	1.75
14	3.65	3.70	6.05	4.00	2.20	1.75	1.90	1.70
15	3.58	3.60	6.05	3.85	2.40	1.78	1.90	1.70
16	3.92	3.80	6.05	3.65	2.20	2.20	1.85	1.70
17	2.55	4.30	6.00	3.48	2.10	2.20	1.85	1.70
18	2.45	4.35	5.25	3.30	2.10	2.20	1.80	1.70
19	2.65	4.55	4.88	3.18	2.10	2.25	1.80	....
20	2.50	4.65	4.72	3.10	2.10	2.25	1.80	....
21	2.72	4.80	4.55	3.00	2.10	2.22	1.75	....
22	3.05	4.85	4.60	3.00	2.10	2.30	1.75	....
23	3.20	5.00	4.65	2.90	2.10	2.30	1.80	....
24	3.40	4.85	4.25	3.20	2.10	2.30	1.80	....
25	3.00	4.68	3.95	3.15	2.10	2.40	1.80	....
26	2.90	4.40	3.85	2.90	2.10	2.60	1.80	....
27	2.50	4.30	4.15	2.70	2.10	2.60	1.75	....
28	2.65	4.30	4.05	2.70	2.05	2.55	1.75	....
29	2.45	4.80	4.05	2.60	1.95	2.40	1.75	....
30	2.65	4.50	4.10	2.60	1.88	2.30	1.75	....
31	....	4.15	....	2.55	1.90	....	1.70	....

NOTE.—Gage heights for April 1 to 16 are for the old station; those for April 17 to May 22 are from a temporary staff gage at the new station, having the same datum as the wire gage which was used after May 22.

Rating tables for Grand River at Hot Sulphur Springs, Colo.

MAY 1, 1905, TO APRIL 16, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.60	240	3.90	360	4.10	450	4.30	560	4.50	680
3.70	280	4.00	400	4.20	500	4.40	620	4.60	750
3.80	320								

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined. This table is for the old station.

Rating tables for Grand River at Hot Sulphur Springs, Colo.—Continued.

APRIL 17 TO NOVEMBER 18, 1906[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	240	2.50	680	3.30	1,375	4.10	2,360	4.90	3,550
1.80	280	2.60	750	3.40	1,480	4.20	2,500	5.00	3,700
1.90	325	2.70	825	3.50	1,590	4.30	2,650	5.20	4,000
2.00	375	2.80	905	3.60	1,710	4.40	2,800	5.40	4,310
2.10	430	2.90	990	3.70	1,830	4.50	2,950	5.60	4,630
2.20	490	3.00	1,080	3.80	1,960	4.60	3,100	5.80	4,950
2.30	550	3.10	1,175	3.90	2,090	4.70	3,250	6.00	5,270
2.40	615	3.20	1,275	4.00	2,220	4.80	3,400	6.20	5,590

[a] This table is applicable only for open-channel conditions. It is based on 7 discharge measurements made during 1906 and is fairly well defined. This tablo is for the new station.

Monthly discharge of Grand River at Hot Sulphur Springs, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	1,480	234	691	41,100
May	3,700	648	2,160	133,000
June	5,350	2,020	3,210	191,000
July	2,650	715	1,530	94,100
August	750	316	491	30,200
September	750	240	457	27,200
October	490	240	338	20,800
November (1-18)	289	240	248	8,850
The period				546,000

NOTE.—The above values are excellent.

GRAND RIVER NEAR KREMMLING, COLO.

This station was established July 24, 1904. It is located at the mouth or upper end of Gore Canyon, about 3 miles southwest of Kremmling, Colo. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 78, where are given also references to publications that contain data for previous years.

Discharge measurements of Grand River near Kremmling, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 4	M. C. Hinderlider	110	539	2.62	707
May 21	do	130	2,188	12.28	7,730
June 22	T. E. Brick	141	2,136	11.20	6,540
July 3	do	133	1,791	9.25	4,500
September 9	A. A. Weiland	110	458	2.88	913
October 18	R. I. Meeker	105	307	2.00	657
December 13[a]	do	100	234	1.20	483

[a] River frozen along left bank; slush ice running.

Daily gage height, in feet, of Grand River near Kremmling, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	4.7	10.3	9.45	5.1	3.0	2.85	2.05	1.6
2	3.5	4.65	10.4	9.5	5.5	3.1	3.45	2.35	1.3
3	2.85	5.0	10.4	9.15	5.05	4.35	3.45	2.3	1.25
4	3.75	5.35	10.3	8.75	4.85	3.9	3.5	2.1	1.3
5	2.8	6.7	10.55	8.5	4.7	3.55	3.45	2.0	1.5
6	3.4	7.35	11.75	8.3	4.7	3.3	3.25	1.9	1.15
7	4.2	7.2	11.4	8.15	4.9	3.05	3.25	1.6	1.5
8	3.75	7.5	9.7	8.25	4.65	3.0	3.15	1.6	1.25
9	3.7	8.2	9.55	8.15	4.4	2.9	3.05	1.7	1.25
10	4.0	9.2	10.75	8.2	4.15	3.0	2.85	1.6	1.2
11	4.35	9.6	12.3	8.3	4.05	2.95	2.7	1.7	1.2
12	4.3	9.9	13.45	8.45	3.95	2.8	2.65	1.6	1.6
13	3.25	9.65	14.6	8.45	4.0	2.45	2.55	1.3	1.15
14	2.65	8.8	15.25	8.8	4.2	2.5	2.45	1.5	1.15
15	2.8	8.4	15.25	8.9	4.45	2.85	2.3	1.75	1.4
16	3.3	9.3	15.1	8.45	4.2	3.75	2.2	1.8	.6
17	4.55	10.4	14.95	7.8	4.0	4.1	2.15	1.3	.85
18	5.35	10.9	13.7	7.4	3.95	3.75	2.0	.7	.5
19	4.55	11.4	13.0	7.2	3.85	3.65	1.85	.95	.45
20	4.9	12.1	12.5	6.8	3.75	3.9	2.1	.8	.6
21	5.6	12.2	12.0	6.6	3.9	3.8	2.0	.75	.65
22	6.35	12.55	11.5	6.6	4.8	3.7	1.6	1.1	1.0
23	7.2	12.8	11.1	6.5	4.65	3.8	1.9	1.05	.95
24	7.5	12.4	10.85	6.6	4.35	3.7	2.2	1.0	.95
25	6.4	11.85	9.8	6.9	4.1	3.65	2.35	1.35	1.1
26	6.1	11.4	9.55	6.35	3.45	4.1	2.15	1.35	.8
27	5.2	10.5	9.65	5.95	3.45	4.85	2.2	1.0	1.15
28	5.0	10.8	9.75	5.9	3.25	4.55	2.2	.95	1.5
29	5.0	12.05	9.35	5.55	3.05	4.2	2.15	1.4	1.2
30	4.9	12.05	9.2	5.3	3.05	4.0	2.1	1.55	1.1
31	....	10.6	....	5.15	3.0	....	2.05	....	1.2

NOTE.—These gage heights are liable to error, on account of uncertainties of the gage datum. River frozen after about December 10.

Rating table for Grand River near Kremmling, Colo.

JANUARY 1, 1905, TO JULY 3, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	260	1.80	490	3.00	830	4.40	1,330	6.80	2,540
.70	275	1.90	515	3.10	865	4.60	1,410	7.00	2,670
.80	290	2.00	540	3.20	900	4.80	1,490	8.00	3,410
.90	305	2.10	565	3.30	935	5.00	1,570	9.00	4,260
1.00	320	2.20	590	3.40	970	5.20	1,650	10.00	5,210
1.10	340	2.30	620	3.50	1,005	5.40	1,750	11.00	6,270
1.20	360	2.40	650	3.60	1,040	5.60	1,850	12.00	7,390
1.30	380	2.50	680	3.70	1,075	5.80	1,950	13.00	8,600
1.40	400	2.60	710	3.80	1,110	6.00	2,050	14.00	9,900
1.50	420	2.70	740	3.90	1,145	6.20	2,170	15.00	11,220
1.60	440	2.80	770	4.00	1,180	6.40	2,290		
1.70	465	2.90	800	4.20	1,250	6.60	2,410		

JULY 4 TO DECEMBER 10, 1906.[b]

0.70	405	1.80	610	2.90	925	4.00	1,320	6.20	2,300
.80	420	1.90	635	3.00	960	4.20	1,400	6.40	2,480
.90	435	2.00	660	3.10	995	4.40	1,480	6.60	2,600
1.00	450	2.10	685	3.20	1,030	4.60	1,570	6.80	2,720
1.10	465	2.20	710	3.30	1,065	4.80	1,660	7.00	2,850
1.20	485	2.30	740	3.40	1,100	5.00	1,750	8.00	3,530
1.30	505	2.40	770	3.50	1,135	5.20	1,840	9.00	4,300
1.40	525	2.50	800	3.60	1,170	5.40	1,940		
1.50	545	2.60	830	3.70	1,205	5.60	2,040		
1.60	565	2.70	860	3.80	1,240	5.80	2,140		
1.70	585	2.80	890	3.90	1,280	6.00	2,250		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-6 and is well defined above gage height 1.6 feet.

[b] This table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during September to December, 1906, and earlier high-water measurements, and is well defined above gage height 1.2 feet.

Monthly discharge of Grand River near Kremmling, Colo., for 1906.

[Drainage area, 2,380 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	3,020	725	1,440	85,700	0.605	0.68
May	8,350	1,430	5,060	311,000	2.13	2.46
June	11,600	4,440	7,080	421,000	2[illegible]7	3.31
July	4,710	1,820	3,290	202,000	1.38	1.59
August	1,990	960	1,400	86,100	.588	.68
September	1,680	785	1,160	69,000	.487	.54
October	1,140	565	817	50,200	.343	.40
November	755	405	546	32,500	.229	.26
December	565	*a* 450	*a* 477	29,300	.200	.23
The period				1,290,000		

a Discharge estimated December 11 to 31.

NOTE.—The accuracy of the above values is a matter of conjecture on account of the uncertainty of the gage heights.

GRAND RIVER, NEAR WOLCOTT, COLO.

This station was established May 27, 1906. It is located at the State bridge, 13 miles north of Wolcott.

A chain gage is attached to the downstream side of the bridge; length of chain 20.88 feet. The gage is read by D. O. Bailey.

Discharge measurements of Grand River near Wolcott, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 27	R. I. Meeker	152	848	6.70	6,230
June 17	do	190	1,231	8.65	11,800
July 13	T. E. Brick	142	637	5.35	4,400
November 22	R. I. Meeker	61	177	1.80	4.8

Daily gage height, in feet, of Grand River near Wolcott, Colo., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		6.7	6.2	3.6	2.5	3.2	2.3	1.8
2		6.78	6.05	3.7	2.5	3.1	2.3	1.8
3		7.05	5.85	3.55	2.6	3.05	2.4	1.9
4		7.0	5.65	3.5	2.6	3.0	2.4	1.9
5		6.75	5.5	3.5	2.7	2.9	2.35	1.9
6		6.75	5.35	3.5	2.7	2.85	2.3	1.95
7		6.7	5.3	3.5	2.6	2.8	2.3	2.0
8		6.45	5.4	3.45	2.6	2.8	2.2	2.0
9		6.6	5.35	3.2	2.6	2.7	2.2	2.0
10		7.05	5.3	3.2	2.6	2.6	2.1	2.0
11		7.75	5.35	3.1	2.6	2.55	2.1	2.0
12		8.75	5.3	3.0	2.55	2.5	2.05	2.1
13		8.35	5.3	3.0	2.4	2.4	2.0	2.1
14		8.15	5.45	2.85	2.3	2.4	2.0	2.1
15		8.85	5.55	2.9	2.45	2.4	1.9	2.1
16		8.7	5.45	3.0	2.65	2.3	1.9	2.1
17		8.7	5.25	3.0	2.7	2.3	1.8	2.1
18		8.35	4.85	2.9	2.8	2.25	1.8	2.1
19		7.35	4.7	2.9	2.9	2.2	1.8	2.1
20		7.0	4.6	2.85	2.9	2.2	1.75	2.0
21		6.9	4.4	2.8	3.05	2.2	1.7	2.0
22		6.85	4.3	2.8	3.15	2.1	1.7	2.0
23		6.9	4.3	2.85	3.35	2.1	1.7	1.9
24		6.5	4.3	2.9	3.5	2.15	1.75	1.85
25		6.15	4.25	2.8	3.6	2.2	1.75	1.85
26		6.05	4.2	2.75	3.7	2.3	1.7	1.75
27	6.7	5.9	4.1	2.75	3.8	2.3	1.8	1.7
28	6.7	5.9	4.0	2.7	3.7	2.4	1.8	1.7
29	7.3	5.9	3.9	2.6	3.45	2.35	1.8	1.75
30	7.35	6.05	3.85	2.6	3.2	2.4	1.75	1.75
31	6.85		3.65	2.6		2.35		1.8

Rating table for Grand River near Wolcott, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	385	2.70	1,015	3.70	1,970	4.70	3,260	6.40	6,230
1.80	430	2.80	1,095	3.80	2,080	4.80	3,410	6.60	6,640
1.90	480	2.90	1,180	3.90	2,200	4.90	3,560	6.80	7,060
2.00	535	3.00	1,270	4.00	2,320	5.00	3,720	7.00	7,500
2.10	595	3.10	1,360	4.10	2,440	5.20	4,040	7.20	7,950
2.20	655	3.20	1,450	4.20	2,570	5.40	4,380	7.40	8,410
2.30	720	3.30	1,545	4.30	2,700	5.60	4,720	7.60	8,890
2.40	790	3.40	1,645	4.40	2,830	5.80	5,080	7.80	9,380
2.50	860	3.50	1,750	4.50	2,970	6.00	5,450	8.00	9,880
2.60	935	3.60	1,860	4.60	3,110	6.20	5,830	9.00	12,600

NOTE.—The above table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is fairly well defined.

Monthly discharge of Grand River near Wolcott, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May (27-31)	8,300	6,850	7,470	74,100
June	12,200	5,260	7,850	467,000
July	5,830	1,920	3,700	228,000
August	1,970	035	1,320	81,200
September	2,080	720	1,200	71,400
October	1,450	505	874	53,700
November	790	385	539	32,100
December	595	385	505	31,100
The period				1,030,000

NOTE.—The above values are good.

GRAND RIVER AT GLENWOOD SPRINGS, COLO.

This station is located in the mountains, midway between the Continental Divide and the Colorado-Utah boundary line, and just above the third large tributary of the Grand, which is called Roaring Fork. It was established May 12, 1899, at the request of the Denver and Rio Grande Railroad Company, and is located at the State street bridge. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 81, where are given also references to publications that contain data for previous years.

Discharge measurements of Grand River at Glenwood Springs, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 8	R. I. Meeker	195	705	4.84	2,240
May 4	do	205	851	5.65	3,350
May 19	E. C. Murphy	217	1,610	8.50	13,900
May 28	R. I. Meeker	214	1,390	8.02	11,300
June 19	do	217	1,560	8.95	15,100
July 15	T. E. Brick	214	1,220	7.20	7,060
November 21	R. I. Meeker	185	449	3.58	810

Daily gage height, in feet, of Grand River at Glenwood Springs, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.25	3.32	3.62	4.62	5.50	7.92	7.40	5.92	4.60	5.80	4.15	3.80
2	3.25	3.30	3.45	4.65	5.42	7.92	7.45	5.95	4.68	5.60	4.15	3.80
3	3.25	3.32	3.40	4.49	5.52	8.00	7.38	6.02	4.65	5.40	4.22	3.78
4	3.28	3.38	3.48	4.29	5.60	7.95	7.30	5.90	5.22	5.20	4.20	3.82
5	3.22	3.35	3.55	4.17	6.10	7.98	7.10	5.85	5.18	5.00	4.12	3.80
6	3.22	3.40	3.50	4.29	6.55	8.62	7.00	5.88	5.08	4.80	4.10	3.72
7	3.28	3.38	3.55	4.62	6.80	8.68	6.95	5.88	5.02	4.70	4.12	3.70
8	3.28	3.35	3.58	4.80	6.90	8.00	6.90	5.60	5.02	4.60	4.18	3.60
9	3.22	3.32	3.68	4.65	7.12	7.80	6.90	5.22	5.02	4.50	4.00	3.68
10	3.22	3.40	3.68	4.62	7.50	8.05	6.90	5.12	5.00	4.40	3.98	3.65
11	3.25	3.4	3.80	4.95	7.80	8.98	6.92	5.02	5.02	4.35	3.98	3.70
12	3.25	3.38	3.82	5.00	7.90	9.78	6.95	5.02	5.08	4.35	4.00	3.72
13	3.30	3.40	3.92	4.98	7.80	10.42	7.00	4.92	5.00	4.30	4.02	3.78
14	3.22	3.40	3.92	4.68	7.45	10.70	7.00	4.92	5.02	4.25	3.95	3.60
15	3.22	3.38	3.78	4.48	7.32	10.60	7.18	4.98	5.12	4.25	4.00	3.40
16	3.20	3.38	3.72	4.45	7.48	10.58	7.08	5.02	5.32	4.18	4.05	3.10
17	3.30	3.40	3.60	4.78	7.95	10.38	6.95	5.02	5.60	4.12	4.08	2.95
18	3.35	3.42	3.52	5.15	8.28	9.90	6.75	4.92	5.80	4.12	3.92	2.98
19	3.28	3.42	3.48	5.42	8.62	8.88	6.55	4.92	5.85	4.12	3.62	3.22
20	3.35	3.40	3.45	5.32	8.95	8.48	6.45	4.85	5.90	4.10	3.32	3.32
21	3.25	3.42	3.60	5.55	9.12	8.25	6.30	4.90	5.95	4.18	3.52	3.48
22	3.05	3.48	3.60	5.88	9.12	8.12	6.25	4.98	6.25	4.18	3.68	3.52
23	3.22	3.42	3.75	6.35	9.25	8.12	6.20	5.12	6.15	4.10	3.68	3.48
24	3.32	3.38	4.02	6.68	9.05	7.98	6.20	5.12	6.12	3.82	3.75	3.55
25	3.32	3.42	4.25	6.52	8.65	7.60	6.22	5.08	6.12	4.05	3.72	3.58
26	3.30	3.38	4.48	6.15	8.42	7.48	6.30	4.95	6.18	4.12	3.72	3.52
27	3.28	3.42	4.48	5.95	8.02	7.45	6.12	4.82	6.30	4.20	3.62	3.58
28	3.28	3.50	4.48	5.65	8.02	7.45	6.02	4.78	6.42	4.20	3.68	3.52
29	3.28	....	4.45	5.58	8.45	7.38	6.10	4.68	6.30	4.25	3.78	3.55
30	3.28	....	4.55	5.58	8.68	7.30	5.92	4.65	6.00	4.22	3.70	3.42
31	3.28	....	4.48	....	8.10	....	5.85	4.62	....	4.20	....	3.42

Rating table for Grand River at Glenwood Springs, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.90	430	3.90	1,080	4.90	2,290	5.90	4,000	7.80	9,380
3.00	480	4.00	1,180	5.00	2,440	6.00	4,210	8.00	10,210
3.10	530	4.10	1,290	5.10	2,590	6.20	4,640	8.20	11,110
3.20	580	4.20	1,400	5.20	2,740	6.40	5,090	8.40	12,090
3.30	630	4.30	1,510	5.30	2,890	6.60	5,580	8.60	13,160
3.40	690	4.40	1,630	5.40	3,050	6.80	6,110	8.80	14,350
3.50	760	4.50	1,750	5.50	3,220	7.00	6,670	9.00	15,660
3.60	830	4.60	1,870	5.60	3,400	7.20	7,260	10.00	22,600
3.70	910	4.70	2,000	5.70	3,590	7.40	7,910		
3.80	990	4.80	2,140	5.80	3,790	7.60	8,620		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1900-1906 and is well defined.

Monthly discharge of Grand River at Glenwood Springs, Colo., for 1906.

[Drainage area, 4,520 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	660	505	610	37,500	0.135	0.16
February	760	630	685	38,000	.152	.16
March	1,810	690	1,060	65,200	.235	.27
April	5,790	1,370	2,780	165,000	.615	.69
May	17,400	3,080	9,750	600,000	2.16	2.49
June	27,600	7,580	13,900	827,000	3.08	3.44
July	8,080	3,900	5,930	365,000	1.31	1.51
August	4,250	1,900	2,770	170,000	.613	.71
September	5,140	1,870	3,340	199,000	.739	.82
October	3,790	1,010	1,730	106,000	.383	.44
November	1,420	642	1,100	65,500	.243	.27
December	1,010	455	801	49,300	.177	.20
The year	27,600	455	3,700	2,690,000	.820	11.16

NOTE.—Values are rated as follows: January, February, and December, good; remainder of 1906 excellent.

GRAND RIVER NEAR PALISADES, COLO.

This station was established April 9, 1902. It is located at the steel highway bridge at the point where the river enters Grand Valley, 2 miles above Palisades, in T. 11 S., R. 98 W., and is above all irrigating ditches supplying water to Grand Valley, with the exception of one pumping plant, which takes about 20 second-feet from the river one-fourth mile above the station. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 84, where are given also references to publications that contain data for previous years.

Discharge measurements of Grand River near Palisades, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	R. I. Meeker	280	930	13.70	3,640
May 5	do	316	1,537	15.60	7,990
May 29	do	379	2,869	19.95	24,900
June 18	do	396	3,402	21.20	30,900
June 29	do	321	2,194	17.65	15,100
July 16	T. E. Brick	321	2,034	16.90	12,300
November 19	R. I. Meeker	255	621	12.60	1,740

Daily gage height, in feet, of Grand River near Palisades, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	12.8	14.9	19.05	16.95	14.55	13.1	14.0
2	12.8	14.8	19.15	16.95	14.7	13.2	13.9
3	12.9	14.75	19.15	16.85	14.7	13.35	13.8
4	12.9	15.0	19.15	17.1	14.55	13.5	13.8
5	13.0	15.6	19.25	16.85	14.35	13.6	13.8
6	13.0	16.45	19.75	16.5	14.25	13.5	13.75
7	13.7	16.9	19.85	16.65	14.15	13.35	13.7
8	13.9	17.15	19.3	16.85	14.2	13.2	13.65
9	13.6	17.5	18.9	16.65	14.15	13.2	13.6
10	13.65	18.05	19.3	16.8	13.95	13.2	13.55
11	13.85	18.65	20.3	16.8	13.85	13.1	13.5
12	14.0	18.95	21.0	16.7	13.7	13.1	13.4
13	13.75	18.85	21.8	16.8	13.85	13.1	13.4
14	13.7	18.25	22.25	16.85	13.85	13.1	13.3
15	13.5	17.75	22.05	17.1	13.75	14.25	13.2
16	13.45	18.1	22.05	17.0	13.75	13.75	13.2
17	13.7	18.75	22.05	16.6	13.8	13.8	13.2
18	14.1	19.3	21.25	16.3	13.75	13.8	13.1
19	14.5	19.75	20.25	16.15	13.7	13.8	13.1
20	14.55	20.4	19.75	15.85	13.65	13.8	13.1
21	14.65	20.45	19.45	15.65	13.65	13.8	13.2
22	15.05	20.65	19.25	15.55	13.6	13.8	13.2
23	15.6	20.7	19.05	15.5	13.7	13.8	13.2
24	16.3	20.75	18.5	15.45	13.9	13.8	13.05
25	16.35	20.35	18.2	15.4	13.75	13.85	12.95
26	15.95	19.5	17.85	15.4	13.55	13.85	13.15
27	15.45	19.05	17.55	15.2	13.45	14.25	13.2
28	15.25	19.25	17.35	15.05	13.35	14.4	13.2
29	15.2	19.75	17.4	14.9	13.3	14.3	13.2
30	15.0	19.9	16.9	14.8	13.15	14.2	13.2
31		19.5		14.6	13.1		13.2

Rating table for Grand River near Palisades, Colo., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
12.80	1,950	13.80	3,640	14.80	5,880	15.80	8,480	17.60	14,630
12.90	2,070	13.90	3,850	14.90	6,120	15.90	8,770	17.80	15,430
13.00	2,200	14.00	4,060	15.00	6,360	16.00	9,070	18.00	16,250
13.10	2,350	14.10	4,270	15.10	6,610	16.20	9,680	19.00	20,530
13.20	2,510	14.20	4,490	15.20	6,860	16.40	10,320	20.00	25,160
13.30	2,680	14.30	4,710	15.30	7,120	16.60	10,980	21.00	30,210
13.40	2,860	14.40	4,940	15.40	7,380	16.80	11,660	22.00	35,590
13.50	3,050	14.50	5,170	15.50	7,650	17.00	12,370	23.00	41,090
13.60	3,240	14.60	5,400	15.60	7,920	17.20	13,100		
13.70	3,440	14.70	5,640	15.70	8,200	17.40	13,850		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906 and is well defined.

Monthly discharge of Grand River near Palisades, Colo., for 1906.

[Drainage area, 8,550 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April	10,200	1,950	4,730	281,000	0.553	0.62
May	28,900	5,760	18,600	1,140,000	2.18	2.51
June	37,000	12,000	23,500	1,400,000	2.75	3.07
July	12,700	5,400	9,820	604,000	1.15	1.33
August	5,640	2,350	3,800	234,000	0.444	.51
September	4,940	2,350	3,340	199,000	0.391	.44
October	4,060	2,140	2,850	175,000	0.333	.38
The period				4,030,000		

NOTE.—The above values are excellent.

FRASER RIVER DRAINAGE BASIN.

FRASER RIVER AT GRANBY, COLO.

Fraser River rises among the peaks of the Front Range in southeastern Grand County, Colo., and flows in a general northwesterly direction to its point of junction with Grand River in the east-central part of Middle Park. The stream receives a number of small tributaries, among which are Elk, St. Louis, Crooked, and Pole creeks, all short mountain streams draining the eastern slopes of the Vasquez Mountains.

The gaging station was established July 28, 1904. It is located on the main road between Coulter and Grand Lake, at the wagon bridge three-fourths mile southwest of Granby and about 4 miles above the mouth of the river, in sec. 9, T. 1 N., R. 76 W. In the 1904 Progress Report this station was called Fraser River, near Coulter, Colo. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 87.

Discharge measurements of Fraser River at Granby, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 16	M. C. Hinderlider	57	149	5.57	472
May 23	do	58	179	6.10	835
June 16	do	61	233	6.57	1,550
June 30	T. E. Brick	58	164	5.65	621
September 10	A. A. Weiland	52	95	4.65	114
December 17[a]	R. I. Meeker	28	27		51

[a] Ice 1.5 feet thick.

Daily gage height, in feet, of Fraser River at Granby, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.9	5.9	5.65	4.9	4.7	4.7	4.6
2		5.0	5.9	5.65	4.95	4.95	4.8	4.6
3		5.1	5.95	5.6	4.9	4.85	4.8	4.6
4		5.35	5.9	5.5	4.85	4.65	4.7	4.6
5		5.45	6.05	5.4	4.9	4.65	4.7	4.6
6		5.4	6.2	5.5	4.9	4.6	4.6	4.6
7		5.25	6.05	5.55	4.85	4.5	4.6	4.6
8		5.3	5.9	5.55	4.8	4.55	4.6	4.45
9		5.45	6.0	5.35	4.75	4.6	4.6	4.45
10		5.6	6.2	5.35	4.8	4.55	4.6	4.4
11		5.05	6.45	5.45	4.75	4.5	4.7	4.4
12		5.6	6.6	5.5	4.7	4.5	4.7	4.45
13		5.55	6.75	5.45	4.7	4.5	4.7	4.5
14		5.25	6.85	5.35	4.75	4.5	4.7	4.5
15	5.35	5.42	6.85	5.2	4.75	4.5	4.7	4.5
16	5.25	5.65	6.7	5.1	4.7	4.7	4.6	4.5
17	5.5	5.85	6.65	4.95	4.7	4.7	4.6	4.4
18	5.2	5.85	6.45	4.85	4.7	4.7	4.6	4.4
19	5.15	5.95	6.2	4.85	4.7	4.7	4.6	4.4
20	5.27	6.05	6.1	5.05	4.7	4.7	4.6	4.4
21	5.5	6.0	6.05	5.0	4.95	4.65	4.6	4.3
22	5.68	6.1	6.05	5.05	5.0	4.6	4.6	4.3
23	5.7	6.2	6.1	4.95	4.85	4.6	4.6	4.3
24	5.45	6.1	5.85	4.95	4.8	4.6	4.6	4.3
25	5.2	6.05	5.65	4.95	4.75	4.6	4.6	4.3
26	5.2	6.0	5.65	5.05	4.7	4.7	4.6	4.3
27	5.35	5.9	5.75	5.0	4.7	4.7	4.6	4.3
28	4.92	6.05	5.8	5.0	4.7	4.7	4.6	4.3
29	5.15	6.15	5.65	5.0	4.7	4.7	4.6	4.3
30	5.0	6.05	5.65	5.0	4.7	4.7	4.6	4.3
31		5.9		4.9	4.7		4.6	

NOTE.—Ice conditions prevailed after November 16.

Rating tables for Fraser River at Granby, Colo.

APRIL 15 TO JUNE 12, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.90	140	5.30	300	5.70	550	6.10	900	6.50	1,300
5.00	170	5.40	350	5.80	630	6.20	1,000	6.60	1,410
5.10	210	5.50	410	5.90	720	6.30	1,100		
5.20	250	5.60	480	6.00	810	6.40	1,200		

[a] This table is applicable only for open-channel conditions. It is based on 2 discharge measurements made during 1906 and the form of the curve used during the first half of 1905, and is not well defined.

Rating tables for Fraser River at Granby, Colo.—Continued.

JUNE 13 TO NOVEMBER 30, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.30	50	4.90	190	5.50	520	6.10	1,040	6.70	1,700
4.40	65	5.00	230	5.60	590	6.20	1,150	6.80	1,810
4.50	80	5.10	275	5.70	670	6.30	1,260		
4.60	100	5.20	330	5.80	750	6.40	1,370		
4.70	125	5.30	385	5.90	840	6.50	1,480		
4.80	155	5.40	450	6.00	940	6.60	1,590		

[a] This table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and the form of previous curves, and is well defined above gage height 4.6 feet.

Monthly discharge of Fraser River at Granby, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April (15–31)	550	146	314	9,960
May	1,000	140	568	34,900
June	1,860	630	1,040	61,900
July	630	172	357	22,000
August	230	125	152	9,350
September	210	80	112	6,660
October	155	100	110	6,760
November	100	50	70.9	4,220
The period				156,000

NOTE.—The above values are good. The discharge remains at about 50 second-feet throughout the winter, as the river is fed by springs.

WILLIAMS FORK DRAINAGE BASIN.

WILLIAMS FORK NEAR HOT SULPHUR SPRINGS, COLO.

Williams Fork rises in the Williams River Mountains in southeastern Grand County, flows in a general northwesterly direction, and unites with Grand River in the central part of Middle Park, Colorado.

The gaging station was established July 25, 1904. It is located at the wagon bridge on the ranch of F. A. Field, in T. 1 N., R. 79 W., about 9 miles west of Hot Sulphur Springs, 4 miles above the mouth of the stream, and below all the tributaries. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 89, where are given also references to publications that contain data for previous years.

Discharge measurements of Williams Fork near Hot Sulphur Springs, Colo., in 1906.

Date.	Hydrographer.	Width	Area of section.	Gage height.	Discharge.
		Feet	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 16	M. C. Hinderlider	28	56	3.47	99
May 19	do	59	118	4.28	520
June 20	T. E. Brick	54	118	4.70	750
July 1	do	53	120	4.50	591
September 9	A. A. Welland	44	74	3.39	76
December 14[a]	R. I. Meeker	26	46	3.22	56

[a] Surface ice along sides of stream.

Daily gage height, in feet, of Williams Fork near Hot Sulphur Springs, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	3.54	4.34	4.48	3.76	3.45	3.51	3.45	3.34
2	....	3.59	4.34	4.45	3.80	3.60	3.50	3.48	3.31
3	....	3.67	4.33	4.49	3.72	3.60	3.50	3.46	3.32
4	....	3.76	4.32	4.34	3.70	3.47	3.56	3.40	3.34
5	....	3.91	4.40	4.30	3.68	3.46	3.50	3.39	3.31
6	....	3.96	4.55	4.30	3.72	3.46	3.50	3.42	3.29
7	....	3.94	4.36	4.26	3.72	3.46	3.50	3.42	3.26
8	....	4.01	4.30	4.30	3.69	3.46	3.50	3.42	3.22
9	3.34	4.05	4.34	4.22	3.64	3.40	3.48	3.26	3.19
10	3.45	4.12	4.48	4.20	3.53	3.40	3.48	3.26	3.25
11	3.55	4.15	4.65	4.22	3.51	3.38	3.47	3.38	3.26
12	3.49	4.14	4.82	4.30	3.51	3.35	3.46	3.28	3.25
13	3.35	4.09	5.02	4.25	3.50	3.35	3.42	3.37	3.24
14	3.23	3.98	5.12	4.22	3.52	3.30	3.40	3.36	3.20
15	3.44	3.99	5.18	4.24	3.51	3.32	3.44	3.38	3.19
16	3.59	4.16	5.12	4.16	3.49	3.68	3.46	3.34	3.16
17	3.62	4.22	5.05	4.14	3.48	3.60	3.46	3.34	....
18	3.62	4.26	4.31	4.10	3.48	3.54	3.44	3.24	....
19	3.61	4.31	4.27	4.09	3.48	3.56	3.41	3.18	....
20	3.70	4.38	4.72	4.02	3.46	3.56	3.48	3.18	....
21	3.68	4.36	4.69	4.00	3.62	3.56	3.36	3.28	....
22	3.95	4.44	4.71	3.98	3.78	3.56	3.29	3.31	....
23	4.04	4.48	4.70	3.94	3.62	3.54	3.30	3.28	....
24	3.89	4.36	4.55	4.00	3.50	3.52	3.48	3.34	....
25	3.72	4.36	4.50	3.92	3.50	3.50	3.52	3.29	....
26	3.68	4.32	4.50	3.86	3.48	3.72	3.48	3.24	....
27	3.62	4.32	4.54	3.84	3.48	3.65	3.48	3.18	....
28	3.50	4.38	4.52	3.82	3.48	3.58	3.48	3.22	....
29	3.60	4.52	4.49	3.79	3.47	3.57	3.48	3.32	....
30	3.62	4.40	4.46	3.78	3.46	3.55	3.46	3.29	....
31	....	4.32	....	3.76	3.45	....	3.47	....	....

NOTE.—Ice conditions after Dec. 16.

Rating table for Williams Fork near Hot Sulphur Springs, Colo., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	25	3.60	130	4.10	335	4.60	650	5.10	1,080
3.20	40	3.70	160	4.20	390	4.70	730	5.20	1,170
3.30	60	3.80	200	4.30	450	4.80	810		
3.40	80	3.90	240	4.40	510	4.90	900		
3.50	105	4.00	285	4.50	580	5.00	990		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906 and is well defined.

Monthly discharge of Williams Fork near Hot Sulphur Springs, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April (9–30)	305	46	139	6,070
May	594	115	374	23,000
June	1,150	432	661	39,300
July	566	184	355	21,800
August	200	92	126	7,750
September	168	60	107	6,370
October	120	58	95.5	5,870
November	100	37	65.6	3,900
December (1–16)	68	34	51.8	1,640
The period				116,000

NOTE.—Values are rated as follows, April to October, excellent; November and December, good.

BLUE RIVER DRAINAGE BASIN.

BLUE RIVER NEAR KREMMLING, COLO.

Blue River rises among the peaks of the Continental Divide in the extreme southeastern part of Summit County, Colo., and flows in a general northwesterly direction until it joins Grand River above the point where the latter stream enters Gore Canyon.

The gaging station was established July 21, 1904. It is located at the State highway bridge on the road between Kremmling and Dillon, Colo., 17 miles from the former and 26 miles from the latter, in T. 2 S., R. 80 W., and is below all tributaries of any importance. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 96, where are given also references to publications that contain data for previous years.

Discharge measurements of Blue River near Kremmling, in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 27 [a]	W. A. Lamb	108	151	2.50	346
May 9	do	131	210	2.90	589
May 26	do	147	371	3.50	1,860
June 7	do	166	541	[b] 4.00	3,280
June 28	do	151	382	3.45	1,730
July 23	do	139	236	3.12	702
August 12	do	125	212	2.82	572
August 26	do	118	182	2.58	420
September 6	do	115	182	2.50	422
September 13	do	110	151	2.45	284
September 28	do	99	125	2.30	211
1906.					
April 15	M. C. Hinderlider	92	121	2.25	193
May 20	do	167	428	3.75	2,540
June 21	T. E. Brick	149	381	3.70	2,400
July 2	do	146	354	3.58	1,990
September 8	A. A. Weiland	115	169	2.51	370
December 13 [c]	R. I. Meeker	48	71	2.32	159

[a] Channel partly filled with ice along sides and piers.
[b] Gage height corrected to agree with reading of staff gage.
[c] Ice along banks and at places in midstream; some slush ice running.

Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.55	2.48	3.50	3.55	3.02	2.60	2.78	2.38	2.28
2	2.25	2.52	3.50	3.45	3.05	2.78	2.72	2.50	2.35
3	2.25	2.55	3.55	3.40	2.95	2.80	2.72	2.45	2.40
4	2.20	2.62	3.45	3.35	2.95	2.70	2.68	2.40	2.40
5	2.35	2.92	3.55	3.35	2.95	2.65	2.75	2.42	2.35
6	2.75	3.02	3.85	3.30	2.98	2.52	2.65	2.38	2.38
7	2.95	3.05	3.55	3.30	2.90	2.55	2.65	2.35	2.30
8	2.55	3.08	3.35	3.35	2.90	2.52	2.60	2.35	2.32
9	2.65	3.35	3.45	3.30	2.82	2.55	2.65	2.35	2.30
10	2.45	3.65	3.80	3.38	2.80	2.60	2.60	2.35	2.32
11	2.45	3.78	4.15	3.40	2.80	2.52	2.62	2.35	2.30
12	2.45	3.75	4.45	3.42	2.80	2.52	2.52	2.28	2.30
13	2.25	3.40	4.60	3.42	2.82	2.58	2.50	2.32	2.30
14	2.10	3.05	4.75	3.42	2.90	2.55	2.50	2.32	2.28
15	2.20	3.18	4.60	3.35	2.85	2.60	2.45	2.35	2.12

Daily gage height, in feet, of Blue River near Kremmling, Colo., for 1906—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	2.50	3.75	4.60	3.35	2.80	2.85	2.48	2.32	2.10
17	2.50	3.50	4.45	3.35	2.75	2.80	2.48	2.30	2.15
18	2.60	3.50	3.75	3.32	2.78	2.70	2.48	2.20	2.22
19	2.55	3.68	3.65	3.25	2.78	2.70	2.45	2.22	2.25
20	2.62	4.05	3.50	3.22	2.80	2.70	2.48	2.10	2.30
21	2.75	3.75	3.60	3.20	2.90	2.72	2.40	2.25	2.38
22	2.88	3.80	3.60	3.15	3.05	2.78	2.40	2.30	2.38
23	3.02	3.85	3.70	3.15	2.90	2.70	2.40	2.30	2.42
24	3.00	3.60	3.45	3.22	2.80	2.62	2.40	2.35	2.45
25	2.75	3.60	3.40	3.22	2.75	2.62	2.42	2.30	2.45
26	2.75	3.45	3.38	3.18	2.75	3.20	2.42	2.25	2.38
27	2.60	3.45	3.40	3.10	2.62	3.05	2.50	2.20	2.35
28	2.50	3.55	3.48	3.15	2.52	2.95	2.50	2.35	2.28
29	2.60	3.80	3.38	3.10	2.52	2.85	2.42	2.25	2.30
30	2.50	3.55	3.48	3.05	2.50	2.80	2.38	2.32	2.28
31		3.45	......	2.98	2.55	......	2.38	......	2.32

Rating table for Blue River near Kremmling, Colo., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	20	2.40	260	3.10	990	3.80	2,690	4.50	5,050
1.80	30	2.50	330	3.20	1,160	3.90	2,990	4.60	5,430
1.90	45	2.60	410	3.30	1,360	4.00	3,300	4.70	5,820
2.00	65	2.70	500	3.40	1,590	4.10	3,630	4.80	6,220
2.10	95	2.80	600	3.50	1,850	4.20	3,970		
2.20	140	2.90	710	3.60	2,120	4.30	4,320		
2.30	195	3.00	840	3.70	2,400	4.40	4,680		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906, and is well defined between gage heights 2.3 feet and 4 feet.

Monthly discharge of Blue River near Kremmling, Colo., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
April (5-30)	600	95	242	12,500
May	2,540	410	1,290	79,300
June	4,860	1,590	2,910	173,000
July	1,590	600	800	49,200
August	655	260	398	24,500
September	500	140	230	13,700
October	195	95	158	9,720
November	195	65	127	7,560
December (1-9)	195	20	89.4	1,600
The period				371,000
1906.				
April	870	95	400	23,800
May	3,460	316	1,730	106,000
June	6,020	1,480	2,690	160,000
July	1,980	814	1,350	83,000
August	915	330	630	38,700
September	1,160	346	519	30,900
October	580	247	359	22,100
November	330	95	210	12,500
December	295	95	207	12,700
The period				490,000

NOTE.—Values are rated as follows: April, and August to November, 1905; April, October and November, 1906, fair. July, 1905, August and September, 1906, good. May and June, 1905, and May to July, 1906, excellent. December of both years, approximate.

EAGLE RIVER DRAINAGE BASIN.

EAGLE RIVER NEAR EAGLE, COLO.

Eagle River, an important headwater tributary of Grand River, rises among the high peaks of the Continental Divide, in Eagle County, Colo., immediately opposite the headwaters of Arkansas River, flows a little north of west for about 20 miles, and then in a general westerly direction to its junction with the Grand. It is a very rapid stream throughout its entire course, flowing alternately through canyons and narrow, terraced valleys.

The drainage area is almost wholly in Eagle County. The upper third of the basin is entirely mountainous, the general elevation at the crest of the divide being 12,000 feet above sea level, with peaks over 14,000 feet in altitude. In this part of its course the river descends in falls and cascades, the average slope above the mouth of Roche Moutonnée Creek being 150 feet per mile. The rocks are about equally divided between metamorphic granites and sedimentary formations. The forest cover is excellent, soil is shallow, and erosion is small. The annual precipitation, which is mostly in the form of snow, varies from 20 to 30 inches. This portion of the basin furnishes 90 per cent of the discharge of the stream.

The lower two-thirds of the basin is also mountainous but is less accentuated, the elevations varying from 7,000 to 11,000 feet. The rocks are largely sedimentary, erosion is greater, and the forest cover is meager. The precipitation is approximately 20 inches.

The principal tributaries of the Eagle are Gore, Roche Moutonnée, Gypsum, and Brush creeks.

Below Wolcott a few small ditches divert water for irrigation of the narrow first bench lands, and there is enough irrigation in Gypsum and Brush Creek valleys to divert the entire flow during the latter part of the season.

The gaging station was established March 12, 1905. It is located at Rule's private road bridge, in T. 5 S., R. 85 W., 2½ miles below Eagle, Colo. The chief object of the station is the collection of power data. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 98.

Discharge measurements of Eagle River near Eagle, Colo., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1905.					
March 18	R. I. Meeker	40	119	0.80	187
May 12	do	50	207	2.20	735
July 10	do	45	233	2.40	794
August 15	do	45	202	1.55	406
September 25	do	60	162	1.30	198
1906.					
April 5	R. I. Meeker	60	173	.95	251
May 3	do	95	226	2.15	685
May 28	do	96	411	4.40	2,650
June 16	do	96	548	5.40	4,960
July 14	T. E. Brick	66	345	3.60	1,730
November 23	R. I. Meeker	65	126	.90	203

NOTE.—These measurements were made at different sections.

Daily gage height, in feet, of Eagle River near Eagle, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.25	1.85	3.9	3.9	2.2	1.3	1.85	1.3	1.15
2	1.05	1.95	4.15	3.5	2.55	1.55	1.8	1.45	1.0
3	1.0	2.15	3.95	3.45	2.2	1.8	1.85	1.4	1.1
4	0.95	2.25	3.85	3.2	2.25	1.85	1.85	1.5	1.1
5	1.0	2.7	4.1	3.2	2.05	1.6	1.8	1.5	1.0
6	1.25	2.95	4.6	3.2	2.0	1.6	1.8	1.5	1.0
7	1.55	2.05	3.9	3.35	2.0	1.5	1.7	1.5	1.0
8	1.3	3.15	3.9	3.15	1.85	1.5	1.6	1.5	1.0
9	1.2	3.55	3.8	3.3	1.8	1.5	1.55	1.45	1.1
10	1.25	3.9	4.6	3.35	1.85	1.5	1.5	1.4	1.1
11	1.35	3.95	5.05	3.25	1.75	1.5	1.5	1.4	1.0
12	1.4	3.95	5.25	3.3	1.75	1.45	1.5	1.35	1.0
13	1.3	3.55	5.7	3.25	1.8	1.4	1.5	1.3	1.0
14	1.25	3.4	5.3	3.55	1.8	1.4	1.4	1.3	0.95
15	1.35	3.45	5.2	3.45	1.85	1.8	1.4	1.3	0.75
16	1.4	3.9	5.15	3.15	1.85	1.85	1.4	1.4	0.8
17	1.75	4.15	5.1	3.05	1.85	1.85	1.3	1.3	0.8
18	1.9	4.5	4.45	2.95	1.8	1.8	1.3	1.3	0.9
19	1.8	4.75	4.25	2.85	1.8	1.8	1.3	1.3	0.9
20	1.95	4.0	4.2	2.85	1.75	1.8	1.4	1.2	0.9
21	2.25	4.7	4.15	2.8	1.8	1.8	1.4	1.1	1.0
22	2.55	4.8	4.1	2.2	1.9	1.8	1.4	1.0	1.0
23	2.0	4.8	4.1	2.0	1.95	1.8	1.35	0.9	1.0
24	2.9	4.4	3.9	2.55	1.85	1.8	1.3	0.9	1.0
25	2.55	4.1	3.65	2.75	1.85	1.8	1.4	0.9	1.0
26	2.45	3.85	3.75	2.55	1.55	2.1	1.45	0.9	1.0
27	2.25	3.8	3.85	2.5	1.45	2.3	1.4	0.95	0.9
28	2.0	4.3	3.85	2.4	1.45	2.0	1.4	1.0	0.9
29	1.9	4.8	3.7	2.3	1.35	1.9	1.4	1.1	0.9
30	1.95	4.1	3.7	2.25	1.3	1.8	1.4	1.1	0.9
31	....	3.9	....	2.2	1.3	....	1.35	....	0.9

Rating table for Eagle River near Eagle, Colo., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	145	1.50	375	2.40	820	3.30	1,465	4.40	2,720
.70	163	1.60	412	2.50	880	3.40	1,550	4.60	3,040
.80	183	1.70	452	2.60	945	3.50	1,640	4.80	3,430
.90	205	1.80	498	2.70	1,015	3.60	1,730	5.00	3,860
1.00	230	1.90	544	2.80	1,085	3.70	1,830	5.20	4,360
1.10	255	2.00	591	2.90	1,155	3.80	1,930	5.40	4,830
1.20	281	2.10	644	3.00	1,230	3.90	2,040	5.60	5,440
1.30	310	2.20	700	3.10	1,305	4.00	2,160	5.80	6,040
1.40	341	2.30	760	3.20	1,385	4.20	2,420	6.00	6,600

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905–6 and is well defined between gage heights 0.8 feet and 5.4 feet.

Monthly discharge of Eagle River near Eagle, Colo., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
March (19-31)	183	154	167	4,310
April	790	154	301	17,900
May	2,870	591	1,470	90,400
June	6,040	1,550	3,160	188,000
July	1,420	432	697	42,900
August	475	218	348	21,400
September	358	218	273	16,200
October	268	205	228	14,000
November	230	183	205	12,200
December	218	163	177	10,900
The period				418,000

Monthly discharge of Eagle River near Eagle, Colo., for 1905–6—Continued.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1906.				
April	1,160	218	499	29,700
May	3,640	521	2,050	126,000
June	5,740	1,780	2,750	164,000
July	2,040	591	1,230	75,600
August	912	310	518	31,900
September	760	310	467	27,800
October	521	310	381	23,400
November	375	205	300	17,900
December	268	173	223	13,700
The period				510,000

NOTE. Values are rated as follows: March and December, 1905, good; remainder of 1905 and 1906, excellent.

ROARING FORK DRAINAGE BASIN.

ROARING FORK AT GLENWOOD SPRINGS, COLO.

This station was established April 6, 1906. It is located at a single-span wooden highway bridge about 500 feet above the mouth of Roaring Fork in the city of Glenwood Springs.

The channel is straight; the right bank is low and overflows at extreme high water, the left is high. The bed of the stream is rough and is composed of cobblestones and bowlders. There is but one channel at all stages and the current is swift.

Discharge measurements are made from the downstream side of the bridge. The initial point for soundings is at the right abutment.

A chain gage, which was read during 1906 by Mrs. C. S. Linsley, is attached to the downstream hand rail; length of chain, 20.44 feet. The bench mark is a cross cut in the upper surface of the first stone below the capstone of the east masonry abutment, upstream side; elevation, 12.94 feet above the datum of the gage.

Discharge measurements of Roaring Fork at Glenwood Springs, Colo., in 1906.

Date	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 8	R. I. Meeker	150	208	1.60	707
May 4	do	155	364	2.60	1,790
May 28	do	167	693	4.58	5,210
June 18	do	171	932	6.00	8,180
June 19	do	170	834	5.50	6,970
July 15	T. E. Brick	163	662	4.35	4,950
November 21	R. I. Meeker	120	163	1.54	465

Daily gage height, in feet, of Roaring Fork at Glenwood Springs, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	2.18	4.50	4.90	3.05	1.98	2.35	1.85	1.55
2	....	2.20	4.65	4.98	3.20	2.15	2.32	1.90	1.55
3	....	2.30	4.55	4.78	3.00	2.22	2.25	1.95	1.52
4	....	2.58	4.32	4.50	2.88	2.12	2.32	1.80	1.60
5	....	3.00	4.80	4.15	2.80	2.10	2.28	1.80	1.60
6	1.65	3.30	5.30	4.05	2.80	2.05	2.20	1.82	1.58
7	1.70	3.35	4.70	4.05	2.70	2.02	2.25	1.80	1.48
8	1.55	3.60	4.48	3.95	2.70	2.00	2.22	1.80	1.50
9	1.58	3.98	4.75	3.95	2.62	2.00	2.20	1.80	1.58
10	1.70	4.12	5.68	4.10	2.52	1.88	2.18	1.80	1.52
11	1.85	4.28	6.15	4.15	2.50	1.95	2.12	1.80	1.50
12	1.75	4.35	6.65	4.10	2.42	1.88	2.10	1.75	1.48
13	1.58	3.95	7.45	4.25	2.52	1.88	2.00	1.70	1.48
14	1.58	3.55	7.45	4.60	2.50	1.90	2.00	1.70	1.45
15	1.65	3.55	7.25	4.48	2.42	2.30	1.95	1.70	1.40
16	1.88	4.10	7.28	4.15	2.48	2.45	1.90	1.70	1.15
17	2.08	4.42	7.35	4.00	2.58	2.32	1.90	1.70	1.22
18	2.15	4.65	5.75	3.90	2.55	2.25	1.80	1.60	1.30
19	2.08	4.90	5.65	3.78	2.50	2.20	1.85	1.50	1.45
20	2.20	5.35	5.50	3.78	2.48	2.20	1.88	1.40	1.55
21	2.68	5.10	5.35	3.70	2.48	2.22	1.95	1.50	1.58
22	2.92	5.40	5.20	3.65	2.48	2.22	1.90	1.65	1.42
23	3.08	5.35	5.30	3.60	2.50	2.20	1.90	1.65	1.42
24	3.10	4.85	4.95	3.58	2.42	2.22	1.80	1.62	1.42
25	2.85	4.30	4.70	3.60	2.28	2.25	1.85	1.60	1.40
26	2.70	4.08	4.78	3.50	2.20	2.45	1.92	1.52	1.42
27	2.48	3.85	4.85	3.38	2.20	2.72	1.85	1.48	1.60
28	2.38	4.52	4.75	3.25	2.10	2.62	1.85	1.60	1.42
29	2.32	5.10	4.38	3.15	2.00	2.48	1.85	1.60	1.45
30	2.32	4.48	4.60	3.00	2.05	2.42	1.85	1.58	1.40
31	....	4.40	....	2.95	2.05	....	1.80	....	1.32

Rating tables for Roaring Fork at Glenwood Springs, Colo.

APRIL 6 TO MAY 8, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	630	2.00	1,070	2.50	1,670	3.00	2,380	3.50	3,180
1.60	710	2.10	1,180	2.60	1,800	3.10	2,530	3.60	3,350
1.70	790	2.20	1,300	2.70	1,940	3.20	2,690		
1.80	880	2.30	1,420	2.80	2,080	3.30	2,850		
1.90	970	2.40	1,540	2.90	2,230	3.40	3,010		

MAY 9 TO DECEMBER 31, 1906.[b]

1.10	200	2.00	910	2.90	2,140	3.80	3,720	5.40	6,940
1.20	250	2.10	1,025	3.00	2,300	3.90	3,910	5.60	7,360
1.30	310	2.20	1,145	3.10	2,470	4.00	4,100	5.80	7,780
1.40	375	2.30	1,275	3.20	2,640	4.20	4.500	6.00	8,200
1.50	445	2.40	1,410	3.30	2,810	4.40	4,900	6.20	8,640
1.60	520	2.50	1,550	3.40	2,990	4.60	5,300	6.40	9,080
1.70	605	2.60	1,690	3.50	3,170	4.80	5,700	6.60	9,520
1.80	700	2.70	1,840	3.60	3,350	5.00	6,100	6.80	9,960
1.90	805	2.80	1,990	3.70	3,530	5.20	6,520	7.00	10,400

[a] This table is applicable only for open-channnel conditions. It is based on 2 discharge measurements made during 1906 and is probably fairly accurate.

[b] This table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and is well defined.

Monthly discharge of Roaring Fork at Glenwood Springs, Colo., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April (6-30)	2,530	670	1,310	65,000
May	6,940	1,280	4,290	264,000
June	11,400	4,740	7,060	420,000
July	6,060	2,220	4,000	246,000
August	2,640	910	1,590	97,800
September	1,870	784	1,150	68,400
October	1,340	700	943	58,000
November	858	375	604	35,900
December	520	225	421	25,900
The period				1,300,000

NOTE.—The above values are good.

GUNNISON RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Gunnison River is formed in Gunnison County, Colo., by the union of East and Taylor rivers, two streams that have their origin among the snow-covered peaks and on the slopes of the Continental Divide in the northeastern part of the county, descend through narrow mountain valleys, and unite about 12 miles above Gunnison. From the junction of these rivers the Gunnison flows west and southwest to the point where it enters Grand River at Grand Junction, in the central part of Mesa County, Colo.

The upper course of the river lies through a broad, mountainous valley, but near the mouth of Lake Fork the valley narrows and the river enters Black Canyon of the Gunnison, through which it winds in a tortuous course for 56 miles between granite walls that rise precipitously 3,000 feet above the water's edge. A short distance below the mouth of North Fork, the largest tributary of the river, the canyon walls break abruptly, and the valley is broad and fertile. Below Delta the river enters another narrow canyon, with walls averaging 800 feet in height, and this continues irregularly to Grand Junction, a few tracts of narrow bottom land lying between the channel and the canyon walls.

As an aid to description the basin may be divided into an upper mountainous area and a lower plateau area, the two being divided roughly by a north-south line drawn through the town of Hotchkiss.

The soil of the lower valleys is chiefly adobe, and the higher mesas have large content of gravel and sand. Groves of quaking aspen, interspersed with large, open grazing plots, cover broad areas of this plateau region. Forests of pine and aspen occur on the top of the Grand Mesa, with piñon pines and cedars along the foothills. In the valleys chico and sagebrush form the controlling vegetation, except along the streams, which are bordered to some extent by cottonwood, willow, and undergrowth.

The chief tributaries of the Gunnison are Ohio, Tomichi, Lake Fork, and Cimarron creeks and Smith, North Fork, and Uncompahgre rivers, North Fork being the largest.

North Fork rises in the Huntsman Hills, 20 miles south of Glenwood Springs, flows in a general south and southwesterly course, and unites with the Gunnison about 8 miles west of Hotchkiss. The drainage area is highly mountainous, except for a small portion which lies below Paonia, extreme points reaching an altitude of 13,000 feet. The mesa lands at the lower end of the valley stand 5,500 feet above sea level. The higher peaks are formed of granitic rocks, but lower down sedimentary formations occupy at least 80 per cent of the area of the basin. The mountains are forested and the mesa lands are covered with sagebrush. All the tillable lands of the North Fork and its tributaries have been brought under cultivation, and irrigation is practiced to such an extent that the entire flow is needed for existing systems.

Uncompahgre River, the principal tributary of the Gunnison from the south, rises among the snowy peaks of the highly serrated Uncompahgre Mountains and flows a little west of north to its junction with the Gunnison at Delta. The basin embraces a mountainous, plateau, and valley area of 1,130 square miles, oblong in shape, the width increasing slightly at the lower end. The mountain area occupies but a small part of the basin, but contributes the perennial waters of the stream. The plateau area is greatest in extent and borders the valley on both sides, the larger Uncompahgre Plateau lying to the southwest. Escarpments are conspicuous features of this plateau. The relief features are terraced mesas flanked by shale buttes and ridges, trenched by deep, narrow canyons. Uncompahgre Valley proper begins at a point near Eldredge siding, on the Denver and Rio Grande Railroad.

The other tributaries of the Gunnison need not here be described. Ohio, Tomichi, Lake Fork, and Cimarron creeks are perennial streams, but almost their entire volume is diverted for irrigation during the growing season, so that very little of their water reaches the Gunnison except at times of heavy storms or during spring floods.

Precipitation records for the Gunnison basin are meager. Those which exist show a range from 9 inches in the plateau region to about 25 inches in the mountains.

The natural flow of the Uncompahgre and North Fork rivers is diverted for irrigation along their respective valleys, and the Gunnison tunnel will divert water from the mountainous area and transmit it to Uncompahgre Valley, which has been an irrigated district since the early eighties.

GUNNISON RIVER AT EAST PORTAL OF GUNNISON TUNNEL, COLO.

This station was established April 1, 1905, and replaces the Cimarron station, 12 miles above. It is located about 100 yards above the portal of the tunnel and is in T. 49 N., R. 7 W., 21 miles by wagon road from Montrose. The object of the station is to determine the volume of flow of the river at this point, as 1,300 second-feet will be diverted by the Gunnison tunnel when it is completed. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 108.

Discharge measurements of Gunnison River at east portal of Gunnison tunnel, Colo., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 1	O. McDermith		1,300	9.05	4,530
May 27	do		1,790	11.80	8,540
June 3	do		2,100	12.80	11,200
June 17	do		1,760	11.25	7,100
June 20	do		1,650	10.60	6,650
June 29	do		1,410	9.25	4,180
July 6	do		1,170	7.60	2,520
July 13	do		1,050	6.85	1,700
August 3	do		1,090	7.12	2,040
August 11	do		917	6.00	1,020
August 19	do		860	5.60	763
August 28	do		846	5.50	689
September 13	do		806	5.24	575
1906.					
April 9	McDermith and Overstreet	149	995	6.39	1,480
April 17	do	153	1,130	7.27	2,240
April 19	do	155	1,170	7.52	2,510
April 21	do	159	1,290	8.14	2,960
May 8	C. Z. Overstreet	174	1,600	10.10	5,770
May 9	do	181	1,700	10.60	6,520
May 11	do	190	1,830	11.30	7,680
May 21	do	202	2,000	12.30	9,810
June 12	O. McDermith	213	2,260	13.70	12,800
June 14	do	216	2,400	14.20	15,000
June 18	C. Z. Overstreet	206	2,090	12.80	10,200
June 23	do	192	1,850	11.30	7,670
July 7	do	164	1,410	9.00	3,750
July 20	do	160	1,290	8.30	2,780
August 13	do	149	1,020	6.80	1,300
September 7	E. F. Kriegsman	146	983	6.15	808
September 24	do	147	962	6.32	982
September 27	do	152	1,110	7.29	1,770

Daily gage height, in feet, of Gunnison River at east portal of Gunnison tunnel, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.3	6.3	6.2	6.4	7.7	11.2	10.1	7.7	6.35	6.8	6.2	6.2
2	6.3	6.3	6.2	6.45	7.7	11.1	10.0	7.7	6.4	6.8	6.2	6.1
3	6.3	6.3	6.3	6.5	7.7	11.1	9.9	7.6	6.55	6.8	6.2	6.0
4	6.3	6.3	6.3	6.55	8.3	11.0	9.75	7.6	6.65	6.7	6.2	6.0
5	6.3	6.3	6.3	6.65	9.0	11.4	9.45	7.35	6.6	6.7	6.2	6.0
6	6.2	6.3	6.3	6.65	9.3	11.5	9.15	7.3	6.4	6.7	6.2	5.9
7	6.2	6.3	6.2	6.65	9.7	11.7	9.0	7.2	6.15	6.55	6.2	
8	6.2	6.3	6.2	6.6	10.05	11.8	9.0	7.1	6.15	6.4	6.2	
9	6.2	6.3	6.2	6.55	10.45	11.8	9.0	7.0	6.1	6.3	6.1	
10	6.2	6.3	6.2	6.7	10.9	12.3	9.1	6.9	6.1	6.3	6.1	
11	6.2	6.3	6.2	6.9	11.3	13.05	9.15	6.8	6.1	6.2	6.0	
12	6.2	6.3	6.2	6.8	10.95	13.8	9.2	6.8	6.0	6.2	5.9	
13	6.2	6.3	6.2	6.65	10.6	14.3	9.2	6.8	5.95	6.2	5.8	
14	6.2	6.3	6.2	6.45	10.15	14.2	9.2	6.8	5.9	6.3	5.8	
15	6.2	6.3	6.2	6.55	10.1	13.9	9.1	6.8	6.25	6.2	5.9	

Daily gage height, in feet, of Gunnison River at east portal of Gunnison tunnel, Colo., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	6.2	6.3	6.2	0.8	10.5	13.8	8.95	6.8	6.65	6.2	5.9	......
17	6.2	6.3	6.2	7.25	11.0	13.5	8.75	6.8	6.85	6.1	5.85	......
18	6.2	6.3	6.2	7.0	11.4	12.7	8.6	6.8	6.75	6.0	5.7	......
19	6.2	6.3	6.2	7.6	11.7	12.0	8.45	6.8	6.55	5.9	5.4	......
20	6.2	6.3	6.2	7.75	12.0	11.4	8.3	6.95	6.35	6.1	5.4	......
21	6.2	6.2	6.2	8.1	12.3	11.4	8.3	7.15	6.3	6.0	5.5	......
22	6.2	6.2	6.2	8.65	12.4	11.4	8.3	7.2	6.3	6.0	6.0	......
23	6.2	6.2	6.3	9.15	12.2	11.15	8.3	7.2	6.3	5.9	6.0	......
24	6.2	6.2	6.4	9.3	11.7	10.6	8.2	7.0	6.3	5.8	6.0	......
25	6.2	6.2	6.5	8.75	10.9	10.3	8.2	6.8	6.4	5.9	6.0	......
26	6.3	6.2	6.5	8.35	10.75	10.3	8.2	6.65	6.45	6.0	5.9	......
27	6.3	6.2	6.4	8.05	10.7	10.3	8.1	6.5	7.3	6.15	5.9	......
28	6.3	6.2	6.4	7.85	11.1	10.3	8.1	6.4	7.4	6.2	6.25	......
29	6.3	......	6.3	7.7	11.7	10.2	8.0	6.35	7.0	6.2	6.3	......
30	6.3	......	6.3	7.7	11.4	10.2	8.0	6.3	6.9	6.1	6.3	......
31	6.3	......	6.3	......	11.0	......	7.85	6.3	......	6.1	......	......

NOTE.—The following ice conditions prevailed during 1906: River frozen January 1 to March 24; March 21 to 24, ice rotten; March 25, ice coming down river; March 26, ice nearly gone; March 27, ice entirely gone above and in front of engineer's camp; November 18 and 19, ice coming down and freezing to banks; November 20, channel partly frozen over; November 22, ice jam below gage; November 25 to December 3 river frozen over at gage, and about 200 feet above and below; December 6, channel open. Thickness of ice in feet: January 1–3, 2.0; January 4, 2.1; January 5–8, 2.2; January 9–20, 2.3; January 21 to February 2, 2.4; February 3 to 6, 2.3; February 7–9, 2.2; February 10–11. 2.1; February 12–16, 2.0; February 17–20, 1.8; February 21 to March 6, 1.7; March 7–16, 1.5; March 17, 1.4; March 18–19, 1.3; March 20, 1.2; March 21–24 (rotten), 1.0.

Rating tables for Gunnison River at east portal of Gunnison tunnel, Colo.

APRIL 9, 1905, TO JUNE 10, 1906.[a]

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.00	400	6.00	1,025	7.00	1,900	8.00	2,920	10.00	5,540
5.10	450	6.10	1,105	7.10	1,995	8.20	3,140	10.20	5,850
5.20	505	6.20	1,185	7.20	2,090	8.40	3,380	10.40	6,170
5.30	560	6.30	1,270	7.30	2,190	8.60	3,620	10.60	6,500
5.40	620	6.40	1,355	7.40	2,290	8.80	3,870	10.80	6,840
5.50	680	6.50	1,440	7.50	2,390	9.00	4,130	11.00	7,200
5.60	745	0.60	1,530	7.60	2,490	9.20	4,390	12.00	9,150
5.70	810	6.70	1,620	7.70	2,590	9.40	4,670	13.00	11,370
5.80	880	6.80	1,710	7.80	2,700	9.60	4,950	14.00	13,900
5.90	950	6.90	1,805	7.90	2,810	9.80	5,240	....	....

JUNE 11 TO DECEMBER 6, 1906.[b]

5.40	380	6.30	930	7.20	1,685	8.20	2,725	10.00	5,200
5.50	430	6.40	1,005	7.30	1,780	8.40	2,960	10.20	5,540
5.60	480	6.50	1,080	7.40	1,875	8.60	3,200	10.40	5,890
5.70	535	6.60	1,160	7.50	1,975	8.80	3,460	10.60	6,250
5.80	595	6.70	1,240	7.60	2,075	9.00	3,720	10.80	6,620
5.90	660	6.80	1,325	7.70	2,180	9.20	4,000	11.00	7,000
6.00	725	6.90	1,410	7.80	2,285	9.40	4,280	12.00	9,070
6.10	790	7.00	1,500	7.90	2,390	9.60	4,580	13.00	11,370
6.20	860	7.10	1,590	8.00	2,500	9.80	4,880	14.00	13,900

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made prior to June 10, 1906, and is well defined.

[b] This table is applicable only for open-channel conditions. It is based on discharge measurements made after June 10, 1906, and is well defined.

Monthly discharge of Gunnison River at east portal of Gunnison tunnel, Colo., for 1905-6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum	Minimum.	Mean.	
1905.				
April 9-30	3,320	950	1,430	62,400
May	9,040	2,490	5,220	321,000
June	13,800	4,200	8,360	497,000
July	3,800	1,440	2,040	125,000
August	2,760	680	1,130	69,500
September	745	450	560	33,300
October	712	450	519	31,900
November	560	400	491	29,200
The period				1,170,000
1906.				
March 27-31	1,360	1,270	1,310	13,000
April	4,530	1,300	2,270	135,000
May	10,000	2,590	6,620	407,000
June	14,700	5,540	8,830	525,000
July	5,370	2,340	3,510	216,000
August	2,180	930	1,470	90,400
September	1,880	660	1,060	63,100
October	1,320	595	905	55,600
November 1-29	860	380	714	28,300
The period				1,530,000

NOTE.—The above values are excellent.

GUNNISON RIVER AT WHITEWATER, COLO.

This station was regularly established April 10, 1902, incomplete series of gage heights having been obtained during 1895, 1897, and 1901. It is located at the steel wagon bridge constructed by the State of Colorado at a point about one-half mile above the railroad station at Whitewater, on the Denver and Rio Grande Railroad. It was intended that this station should replace that formerly maintained on the Gunnison at Grand Junction, which was abandoned on account of conditions that rendered accurate gagings impossible. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 112, where are given also references to publications that contain data for previous years.

Discharge measurements of Gunnison River at Whitewater, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 12	R. I. Meeker	278	1,110	6.35	3,440
May 6	do	278	2,190	10.22	11,600
May 18	E. C. Murphy	277	2,710	11.85	16,900
May 30	R. I. Meeker	278	2,790	12.12	18,200
June 20	do	278	2,430	10.86	13,300
November 20	do	244	592	4.20	956

Daily gage height, in feet, of Gunnison River at Whitewater, Colo., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	5.12	7.50	11.40	8.35	6.10	4.50	5.50
2	5.22	7.45	11.50	8.55	6.00	5.00	5.35
3	5.12	7.80	11.55	8.45	6.35	5.00	5.30
4	4.97	8.20	11.25	8.25	6.15	4.85	5.20
5	5.17	9.20	11.20	8.10	5.95	4.75	5.20
6	5.32	9.90	11.60	7.80	5.80	4.70	5.15
7	5.97	10.30	11.60	7.75	5.75	4.55	5.10
8	6.27	10.45	11.15	7.70	5.60	4.50	5.10
9	6.02	11.05	11.00	7.60	5.50	4.50	5.00
10	5.62	11.45	11.45	7.45	5.35	4.40	4.90
11	6.12	11.80	12.00	7.35	5.05	4.40	4.80
12	6.42	12.05	12.50	7.40	5.00	4.35	4.75
13	6.07	11.65	12.95	7.30	5.00	4.25	4.70
14	5.72	11.40	13.10	7.30	5.00	4.20	4.70
15	5.95	10.80	12.90	7.45	5.05	4.65	4.70
16	6.35	11.20	12.65	7.30	5.00	5.35	4.70
17	7.05	11.45	12.45	7.05	5.10	5.45	4.70
18	7.25	11.75	12.10	6.85	5.10	5.30	4.65
19	7.60	12.25	11.10	6.90	5.10	5.05	4.65
20	7.55	12.80	10.80	6.75	5.05	5.00	4.70
21	8.10	13.05	10.60	6.60	5.05	4.75	4.90
22	8.75	13.00	10.45	6.30	5.25	4.85	5.00
23	9.35	12.80	10.15	6.30	5.45	5.00	4.85
24	9.90	12.65	9.90	6.20	5.35	5.00	4.80
25	9.55	12.55	9.55	6.40	5.15	4.95	4.70
26	8.75	11.60	8.90	6.35	4.95	5.10	4.75
27	8.15	10.80	8.70	6.30	4.90	5.30	4.85
28	7.75	11.45	8.65	6.35	4.75	5.95	5.00
29	8.05	12.05	8.55	6.30	4.65	5.65	5.00
30	7.90	11.95	8.35	6.30	4.55	5.55	4.90
31	......	11.45	......	6.25	4.50	....	4.90

Rating table for Gunnison River at Whitewater, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.20	1,050	5.20	1,970	6.20	3,190	7.40	5,040	9.40	9,390
4.30	1,130	5.30	2,075	6.30	3,330	7.60	5,400	9.60	9,900
4.40	1,210	5.40	2,185	6.40	3,480	7.80	5,790	9.80	10,420
4.50	1,290	5.50	2,295	6.50	3,630	8.00	6,190	10.00	10,970
4.60	1,380	5.60	2,415	6.60	3,780	8.20	6,605	11.00	13,980
4.70	1,470	5.70	2,535	6.70	3,930	8.40	7,025	12.00	17,430
4.80	1,560	5.80	2,665	6.80	4,080	8.60	7,460	13.00	21,400
4.90	1,660	5.90	2,795	6.90	4,230	8.80	7,915		
5.00	1,760	6.00	2,925	7.00	4,390	9.00	8,400		
5.10	1,865	6.10	3,055	7.20	4,710	9.20	8,890		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902-1906 and is well defined.

Monthly discharge of Gunnison River at Whitewater, Colo., for 1906.

[Drainage area, 7,870 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum	Mean.		Sec. ft. per sq. mile.	Depth in inches.
April	10,700	1,730	4,590	273,000	0.583	0.65
May	21,700	5,130	14,800	910,000	1.88	2.17
June	21,900	6,920	14,400	857,000	1.83	2.04
July	7,350	3,190	4,710	290,000	.598	0.69
August	3,400	1,290	2,080	128,000	.264	0.30
September	2,860	1,050	1,680	100,000	.213	0.24
October	2,300	1,420	1,690	104,000	.215	0.25
The period	....	....	....	2,660,000	....	....

NOTE.—Values are rated as follows: April to July, excellent; August to October, good.

NORTH FORK OF GUNNISON RIVER NEAR HOTCHKISS, COLO.

This station was established April 13, 1904, and discontinued March 31, 1906. It is located 4 miles below Hotchkiss, Colo., on the ranch of L. Gorsuch, and replaces the station maintained during 1903 at the highway bridge one-half mile east of Hotchkiss and abandoned because of unsatisfactory conditions. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 115, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of North Fork of Gunnison River near Hotchkiss, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1	2.30	1.95	1.85	17	2.25	2.00	1.95
2	2.30	1.95	1.80	18	2.18	1.98	2.00
3	2.25	2.00	1.78	19	2.20	1.95	1.92
4	2.25	2.02	1.75	20	2.25	1.95	1.90
5	2.20	2.05	1.75	21	2.20	1.90	2.25
6	2.20	2.10	1.80	22	2.15	1.92	2.15
7	2.15	2.10	1.85	23	2.10	1.95	2.10
8	2.18	2.10	1.85	24	2.08	1.92	2.25
9	2.22	2.05	1.90	25	2.05	1.88	2.50
10	2.30	2.05	1.90	26	2.00	1.88	3.10
11	2.32	2.10	2.00	27	2.00	1.88	2.55
12	2.35	2.10	2.00	28	2.00	1.85	2.55
13	2.40	2.08	2.05	29	2.00	....	2.50
14	2.40	2.02	2.28	30	2.00	....	2.45
15	2.38	2.02	2.10	31	2.00	....	2.58
16	2.32	2.02	2.00				

UNCOMPAHGRE RIVER NEAR COLONA, COLO.

This station was established April 9, 1904. It is located at the private road bridge of J. M. Duckett, in T. 47 N., R. 8 W., one-half mile above Eldredge siding on the Denver and Rio Grande Railroad and 3 miles above Colona, Colo. It is best reached by driving from Montrose. The station replaces one that was established August 10, 1903, at Kettle's bridge, 1 mile south of Colona, to take the place of the original station, which was located one-half mile northeast of Colona. Both of these stations were abandoned because of unsatisfactory conditions. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 120, where are given also references to publications that contain data for previous years.

Discharge measurements of Uncompahgre River near Colona, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 15	R. I. Meeker	45	60	1.42	188
May 8	do	47	112	2.38	653
June 1	do	47	121	2.48	792
June 22	do	47	191	....	1,120

Daily gage height, in feet, of Uncompahgre River near Colona, Colo., for 1906.

Day.	Apr.	May.	June.	Day.	Apr.	May.	June.
1	....	1.75	2.50	17	1.60	2.55	....
2	....	1.70	2.30	18	1.68	2.70	....
3	....	1.70	2.50	19	1.70	3.00	....
4	....	2.00	2.30	20	1.68	2.90	....
5	....	2.35	2.55	21	1.95	2.75	....
6	....	2.35	2.50	22	2.25	2.85	....
7	....	2.35	2.60	23	2.55	2.70	....
8	....	2.50	2.55	24	2.20	2.50	....
9	....	2.45	3.15	25	2.00	2.50	....
10	....	2.35	3.35	26	2.00	2.20	....
11	....	2.35	....	27	1.90	2.50	....
12	....	2.55	....	28	1.85	2.80	....
13	....	2.45	....	29	1.85	2.70	....
14	....	2.20	....	30	1.85	2.55	....
15	1.42	2.25	....	31	....	2.35	....
16	1.45	2.45	....				

NOTE.—The gage was displaced, the bench-mark destroyed, and the channel changed, about June 10, records after that date are of no value.

UNCOMPAHGRE RIVER AT MONTROSE, COLO.

This station was established April 22, 1903. It is located at the iron highway bridge west of Montrose and one-fourth mile west of the Denver and Rio Grande Railroad near Haskell Park. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 122, where are given also references to publications that contain data for previous years.

Discharge measurements of Uncompahgre River at Montrose, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 14	R. I. Meeker	31	33	1.85	47
May 7	do	35	82	3.32	380
June 1	do	40	87	3.50	414
June 22	do	42	106	3.89	542

Daily gage height, in feet, of Uncompahgre River at Montrose, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.00	2.15	2.08	2.15	2.48	3.50	3.60	2.70	1.68	2.35	2.20	2.48
2	2.00	2.08	1.98	1.95	2.45	3.62	3.40	2.85	1.80	2.20	2.25	2.50
3	2.25	2.12	1.75	1.92	2.45	3.30	3.05	2.70	1.70	2.25	2.05	2.50
4	2.05	2.08	1.92	1.95	2.85	3.05	2.88	2.60	1.62	2.12	2.15	2.60
5	2.30	2.10	1.92	2.10	3.15	3.62	2.75	2.55	1.55	2.15	1.90	2.55
6	2.28	2.10	1.88	2.00	3.30	3.58	2.58	2.35	1.50	2.08	1.98	2.45
7	2.08	2.08	1.90	2.35	3.45	3.60	2.45	2.20	1.52	2.02	1.95	2.40
8	2.22	2.06	1.88	2.18	3.62	3.58	2.78	2.10	1.62	2.02	2.00	2.35
9	2.25	2.02	1.98	2.15	3.90	3.80	2.02	1.98	1.95	2.00	1.95	2.45
10	2.15	2.08	2.00	2.40	3.65	4.55	2.60	1.95	1.88	1.95	1.98	2.45
11	2.20	2.05	2.05	2.42	3.80	5.10	3.05	1.92	1.90	1.90	2.05	2.50
12	2.00	2.06	1.96	2.18	3.88	5.45	3.18	1.90	1.95	1.85	1.92	2.50
13	2.08	2.05	1.95	1.98	3.32	5.88	3.10	1.95	1.92	1.90	1.92	2.48
14	2.05	1.95	2.00	1.98	3.12	5.45	3.18	2.12	2.02	1.90	1.92	2.38
15	2.10	2.02	1.90	2.05	3.08	5.60	3.10	2.10	2.35	1.98	1.82	2.28
16	2.00	2.05	1.90	2.08	3.45	5.75	2.95	2.05	2.78	1.92	1.92	2.20
17	2.10	2.08	1.82	2.28	3.55	5.75	2.72	2.12	2.25	1.98	1.90	2.25
18	2.10	1.95	1.88	2.50	4.02	4.80	2.90	2.25	2.05	1.95	2.05	2.25
19	2.22	2.00	1.88	2.55	4.30	4.60	2.75	1.95	2.00	1.80	2.02	2.35
20	2.10	2.02	1.75	2.52	4.55	4.85	2.88	1.95	2.05	1.95	2.08	2.38

Daily gage height, in feet, of Uncompahgre River at Montrose, Colo., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2.18	2.00	1.98	2.88	4.15	3.82	2.80	2.25	2.10	2.05	2.15	2.35
22	2.10	2.02	2.02	3.22	4.28	3.88	2.65	2.20	2.05	1.95	2.15	2.35
23	2.50	1.98	2.10	3.60	4.02	3.80	2.75	2.05	1.82	2.05	2.25	2.30
24	2.08	1.90	2.30	3.70	3.82	3.60	3.25	2.30	1.90	2.05	2.40	2.32
25	2.00	1.90	2.25	3.20	3.65	3.45	2.90	2.05	2.40	2.15	2.20	2.32
26	2.05	1.92	2.15	2.85	3.48	3.52	2.75	1.92	2.25	2.25	2.35	2.35
27	2.08	1.92	2.12	2.55	3.25	3.35	3.15	1.92	2.50	2.20	2.40	2.30
28	2.02	2.02	2.10	2.65	3.70	3.20	3.25	1.88	2.45	2.35	2.50	2.30
29	2.08	......	2.12	2.70	3.95	3.00	3.05	1.88	2.30	2.15	2.52	2.25
30	2.02	......	2.02	2.72	3.58	3.40	3.08	1.88	2.35	2.05	2.48	2.30
31	2.00	......	2.00	......	3.50	......	2.80	1.68	......	2.15	......	2.40

Rating tables for Uncompahgre River at Montrose, Colo.

JANUARY 1, 1905, TO APRIL 22, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	32	2.10	69	2.40	111	2.70	163	3.00	231
1.80	39	2.20	82	2.50	127	2.80	184	3.10	257
1.90	47	2.30	96	2.60	144	2.90	207	3.20	285
2.00	57								

APRIL 23, 1906, TO DECEMBER 31, 1906.[b]

1.50	32	2.20	116	2.90	262	3.60	461	4.60	850
1.60	40	2.30	133	3.00	288	3.70	493	4.80	970
1.70	50	2.40	151	3.10	315	3.80	526	5.00	1,125
1.80	61	2.50	170	3.20	343	3.90	560	5.20	1,300
1.90	73	2.60	191	3.30	371	4.00	595	5.40	1,500
2.00	86	2.70	213	3.40	400	4.20	671	5.60	1,725
2.10	100	2.80	237	3.50	430	4.40	755	5.80	1,970

[a] This table is applicable only for open-channel conditions. It is based on one discharge measurement made during 1906 and the form of previous curves and is not well defined.

[b] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906 and is well defined between gage heights 2 feet and 4 feet.

Monthly discharge of Uncompahgre River at Montrose, Colo., for 1906.

[Drainage area, 565 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	127	57	71.9	4.420	0.127	0.15
February	76	47	60.6	3.370	0.107	.11
March	96	36	56.9	3,500	0.101	.12
April	493	49	150	8,930	0.265	.30
May	825	160	456	28,000	0.807	.93
June	2,070	288	796	47,400	1.41	1.57
July	461	160	276	17,000	0.488	.56
August	250	48	111	6,820	0.196	.23
September	232	32	93.1	5,540	0.165	.18
October	142	61	94.9	5,840	0.168	.19
November	174	73	105	6,460	0.186	.21
December	191	116	148	9,100	0.262	.30
The year	2,070	32	202	146,000	.357	4.85

NOTE.—Values are rated as follows: January to March, August to December, fair; April and July, good; May and June, excellent.

UNCOMPAHGRE RIVER AT DELTA, COLO.

This station was established April 29, 1903. It was originally located at a highway bridge one-fourth mile above the Denver and Rio Grande Railroad bridge, but on November 17, 1903, the station was removed to the Denver and Rio Grande Railroad bridge, one-fourth mile northwest of the Denver and Rio Grande Railroad station, in order that the measured discharge of the river might include the mill-ditch waste. Excluding the discharge of seasonal high water in May or June and an occasional rise from local storms, the water passing this station is entirely seepage water from irrigation above. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 125, where are given also references to publications that contain data for previous years.

Discharge measurements of Uncompahgre River at Delta, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 13	R. I. Meeker	55	51	1.15	63
May 8	do	65	176	3.20	867
May 9	do	65	176	3.18	844
May 30	do	65	184	3.25	850
May 31	do	65	172	3.01	722

Daily gage height, in feet, of Uncompahgre River at Delta, Colo., for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.51	0.88	1.82	2.83	1.82	1.47	0.98	1.63	1.84
2	1.42	0.88	1.64	2.78	1.81	1.80	1.08	1.63	1.85
3	1.36	0.90	1.62	2.62	1.68	1.76	1.10	1.56	......
4	1.37	0.95	1.71	2.48	1.60	1.67	1.10	1.50	......
5	1.37	0.90	2.37	2.53	1.48	1.60	1.04	1.49	......
6	1.31	0.89	2.57	2.35	1.22	1.67	1.02	1.52	......
7	1.28	0.96	2.92	2.10	1.17	1.47	1.03	1.52	......
8	1.22	1.18	3.07	2.24	1.39	1.36	1.01	1.51	......
9	1.27	1.02	3.27	2.22	1.18	1.25	1.01	1.46	......
10	1.16	1.01	3.21	2.50	1.06	1.15	1.00	1.40	......
11	0.99	1.44	3.25	3.05	1.06	1.04	1.06	1.36	......
12	1.08	1.40	3.33	3.28	1.21	1.05	1.04	1.38	......
13	1.19	1.16	3.36	3.52	1.16	1.05	1.02	1.39	......
14	1.23	0.98	3.17	3.91	1.09	1.04	1.01	1.41	......
15	1.12	0.88	2.91	3.70	1.26	1.06	1.23	1.42	......
16	1.01	0.90	2.98	3.71	1.20	1.09	1.67	1.41	......
17	1.02	0.91	3.25	3.87	1.15	1.06	1.91	1.40	......
18	1.01	1.30	3.48	3.77	1.09	1.11	1.51	1.38	......
19	0.97	1.59	3.65	3.06	1.38	1.10	1.42	1.37	......
20	0.98	1.59	3.82	3.00	1.30	1.04	1.37	1.52	......
21	1.06	1.87	3.92	2.78	1.27	1.07	1.39	1.65	......
22	1.18	2.46	3.80	2.52	1.20	1.34	1.36	1.65	......
23	1.18	2.93	3.56	2.54	1.14	1.56	1.36	1.63	......
24	1.14	3.22	3.65	2.39	1.19	1.38	1.41	1.71	......
25	1.27	2.61	4.10	2.22	1.58	1.20	1.48	1.70	......
26	1.28	2.29	3.37	2.17	1.25	1.15	1.69	1.75	......
27	1.29	2.10	3.02	2.09	1.50	1.13	1.80	1.79	......
28	1.14	1.86	3.15	1.95	1.63	1.06	1.84	1.83	......
29	1.11	2.03	3.42	1.79	1.86	1.04	1.78	1.85	......
30	1.01	1.72	3.26	1.80	1.87	0.99	1.69	1.81	......
31	0.92	......	3.04	......	1.61	1.00	......	1.73	......

NOTE.—The river was gorged with ice during January and February.

Rating table for Uncompahgre River at Delta, Colo., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	27	1.60	152	2.30	383	3.00	725	3.70	1,190
1.00	38	1.70	179	2.40	425	3.10	785	3.80	1,265
1.10	51	1.80	208	2.50	470	3.20	845	3.90	1,345
1.20	67	1.90	239	2.60	515	3.30	910	4.00	1,425
1.30	85	2.00	272	2.70	565	3.40	975	4.10	1,510
1.40	105	2.10	307	2.80	615	3.50	1,045		
1.50	128	2.20	344	2.90	670	3.60	1,115		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906 and is well defined.

Monthly discharge of Uncompahgre River at Delta, Colo., for 1906.

[Drainage area, 1,130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
March	130	29	65.6	4,030	.058	.07
April	858	25	175	10,400	.155	.17
May	1,510	157	827	50,800	.732	.84
June	1,350	205	629	37,400	.557	.62
July	230	46	108	6,640	.096	.11
August	208	37	82.8	5,090	.073	.08
September	242	36	97.7	5,810	.086	.10
October	224	97	145	8,920	.128	.15
The period				129,000		

NOTE.—Values are rated as follows: May and June, excellent; remainder of the period, good.

COLORADO RIVER DRAINAGE BASIN BETWEEN JUNCTION OF GRAND AND GREEN RIVERS AND YUMA.

COLORADO RIVER.

DESCRIPTION OF RIVER.

From the junction of Grand and Green rivers the Colorado flows southwestward, passes across the northwestern corner of Arizona, then turns to the south and for the remainder of its course forms a part of the southeastern boundary of Nevada and California and the western boundary of Arizona. It empties into the Gulf of California about 60 miles below Yuma, Ariz. The canyons through which it flows are world famed and need not here be described.

The Colorado has been called the Nile of America, and like the Nile it is subject to an annual summer rise which comes at the time when it is most needed for irrigation. It is of interest to compare the Colorado with Nile and Susquehanna rivers. The Nile is similar in type, while the Susquehanna shows the difference in flow between arid and humid regions. In the comparison a normal year based upon records of the past ten years for the Colorado and Susquehanna rivers and such data as could be found in regard to the

Nile have been used. The Colorado has been taken as the standard of comparison.

The Nile has 5.7 times the drainage area and the Susquehanna about one-eighth the area of the Colorado.

The rainfall in the Nile basin is 3.8 times greater; that in the Susquehanna basin is 4.5 times greater. The run-off per square mile from the Nile basin is 1.9 times greater; that from the Susquehanna basin is 37 times greater. The ratio of run-off to rainfall in the Nile basin is 2 times smaller; that of the Susquehanna basin is 8.2 times greater.

The discharge of the Nile is 10.8 times greater; that of the Susquehanna is 4.5 times greater.

The maximum flow of the Colorado is from 70,000 to 110,000 second-feet and occurs in May, June, or July; for the Nile it is about 353,000 second-feet and occurs about the first of September; for the Susquehanna it is from 200,000 to 400,000 second-feet and occurs during March, April, and May.

The minimum flow of the Colorado is from 2,500 to 3,000 second-feet and occurs during January and February; that of the Nile is about 14,500 second-feet and occurs about the end of May; for the Susquehanna it is from 2,500 to 5,000 second-feet and occurs in September and October.

The mean flow of the Colorado is about 10,700 second-feet; for the Nile it is about 115,800 second-feet; for the Susquehanna it is about 43,000 second-feet.

The water of the Colorado carries an immense amount of sediment, reaching as high as 2,000 parts of sediment to 100,000 parts of water. Prof. R. H. Forbes, in Bulletin No. 44, University of Arizona Agricultural Experiment Station, says:

> On the basis of the profile constructed from available data for the volume of flow of the Colorado, and of the year's silt determinations made in the laboratory, it is estimated conservatively that the river during 1900 brought down about 61,000,000 tons of sedimentary material, which, condensed to the form of solid rock, is enough to cover 26.4 square miles 1 foot deep, or to make about 164 square miles of recently settled, submerged mud 1 foot deep, reckoning the whole amount of mud for the year to average 6.2 times the bulk of the solid sediment.

A comparatively small amount of land is irrigated by the waters of the Colorado, owing to the fact that the stream and its tributaries are situated so far below the level of the irrigable lands as to render their diversion extremely difficult or impracticable. There are two pumping plants that lift water for irrigation at Yuma and several at other points on the river above Yuma. The Imperial canal diverts water from the river at a point about 10 miles by river below Yuma.

The principal tributaries of the Colorado below the Grand and Green are San Juan, Little Colorado, Williams Fork, and Gila rivers, which enter from the east, and Virgin River, which enters from the west. With the exception of Virgin River and Williams Fork, these streams and their various tributaries are described in other parts of this report.

COLORADO RIVER AT HARDYVILLE, ARIZ.

This station was established May 11, 1905. It is maintained in cooperation with the State of California, and is located one-fourth mile above the deserted town of Hardyville and 7 miles above Fort Mohave, Ariz. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 128.

Discharge measurements of Colorado River at Hardyville, Ariz., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 1	C. W. Jenkins	440	1,530	3.70	3,430
January 7	do	430	1,460	3.50	3,440
January 14	do	430	1,310	3.30	3,360
January 21	do	435	1,660	4.15	5,900
January 28	do	435	1,840	4.50	7,850
February 5	do	435	1,680	4.10	5,110
February 12	do	435	1,720	4.40	6,390
February 25	do	435	1,590	4.30	6,350
March 4	do	372	1,470	4.10	5,710
March 11	do	375	1,460	4.20	1,520
March 18	do	445	3,180	6.40	19,400
March 25	do	445	2,630	5.80	12,800
April 1	do	455	4,320	7.50	30,000
April 8	do	455	3,600	6.90	21,500
April 15	do	455	3,750	7.30	24,100
April 22	do	470	4,480	8.10	32,200
April 24	Murphy and Lee	470	5,010	8.84	37,500
May 3	Lee and Jenkins	460	5,110	9.00	40,800
May 6	C. W. Jenkins	470	4,600	8.70	33,100
May 13	do	485	7,090	11.20	67,200
May 20	C. H. Lee	497	7,960	11.90	63,700
May 27	C. W. Jenkins	550	9,400	14.60	92,800
June 3	do	500	10,700	14.05	96,200
June 9	do	500	10,400	13.10	92,000
June 16	do	500	9,060	14.40	109,000
July 1	F. T. Cavin	470	8,860	10.35	63,700
July 8	Lee and Cavin	470	7,090	9.30	47,500
July 15	F. T. Cavin	468	5,500	8.50	34,600
July 22	do	468	5,990	8.56	38,100
July 29	do	464	4,800	7.55	27,600
August 5	do	462	4,070	7.35	24,400
August 11	do	460	3,540	7.00	19,500
August 18	do	455	3,070	6.45	16,200
August 25	do	452	2,860	6.20	14,200
September 1	do	454	2,900	6.50	15,500
September 8	do	459	2,770	6.63	12,700
September 15	do	456	2,520	6.50	11,400
September 22	C. J. Brunk	460	2,390	6.73	12,100
September 29	do	464	3,110	7.38	16,900
October 6	do	466	3,200	7.63	16,000
October 13	do	455	2,470	7.00	12,000
October 20	do	451	2,150	6.75	9,840
October 28	do	452	1,910	6.60	8,400
November 4	do	445	1,930	6.80	9,470
November 10	do	461	2,290	7.30	12,800
November 17	do	458	2,180	7.15	10,300
November 24	do	455	1,960	6.85	9,430
December 1	do	450	1,750	6.70	7,720
December 8	do	470	3,420	8.48	23,300
December 15	do	451	2,410	7.25	11,300
December 22	do	449	1,890	6.89	9,230
December 29	do	398	1,530	6.50	7,160

Daily gage height, in feet, of Colorado River at Hardyville, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	......	4.4	7.85	9.5	13.2	10.25	7.4	6.5	......	6.65	6.7
2	3.50	4.1	4.2	8.25	9.2	13.8	10.0	7.4	6.35	7.5	6.6	6.65
3	3.5	4.05	4.2	7.9	9.1	14.0	......	7.6	6.35	7.7	......	6.7
4	3.4	4.1	4.1	7.4	9.2	13.8	9.4	7.5	6.5	7.7	6.8	6.65
5	3.35	4.1	4.1	7.45	8.9	13.75	9.4	7.35	6.5	7.7	6.75	6.6
6	3.4	4.1	4.1	7.1	8.8	13.8	9.2	7.2	6.55	7.6	......	6.8
7	3.5	4.2	4.1	6.85	8.7	13.6	9.35	7.0	6.55	7.4	6.9	7.45
8	3.35	4.2	4.2	6.9	8.1	13.3	9.25	7.1	6.7	7.3	6.9	8.45
9	3.3	4.3	4.2	6.9	8.7	13.0	9.35	7.0	6.7	7.2	7.0	7.9
10	3.45	4.4	4.2	6.9	9.3	13.1	9.1	7.0	6.7	7.1	7.3	7.7
11	3.3	......	4.25	7.1	10.1	13.25	8.9	7.05	6.55	7.1	7.3	......
12	3.35	4.4	4.2	7.1	10.5	13.5	8.8	6.85	6.6	7.1	......	7.5
13	3.3	4.4	4.35	7.6	11.05	13.1	8.8	6.8	6.55	7.0	7.3	7.4
14	3.4	4.4	4.5	7.5	11.85	13.95	8.45	6.7	6.55	7.0	7.2	7.3
15	3.35	4.3	5.1	7.35	11.9	......	8.5	6.65	6.55	6.95	7.15	7.25
16	3.4	4.3	......	7.4	12.5	14.1	8.35	6.6	6.55	6.9	7.15	7.1
17	3.7	4.3	6.4	7.45	12.75	14.6	8.55	6.55	6.5	6.85	7.15	6.95
18	3.8	4.25	6.35	7.6	12.6	14.8	8.5	6.45	6.6	6.8	7.1	6.95
19	3.9	4.2	5.9	7.6	12.1	15.2	8.55	6.45	6.9	6.8	7.0	6.9
20	4.2	4.1	5.8	7.6	11.9	15.4	8.65	6.25	6.7	6.75	6.9	6.9
21	4.15	4.2	5.9	7.9	12.3	15.0	8.75	6.2	6.6	6.7	6.85	6.9
22	4.5	......	5.9	8.1	12.75	15.0	8.6	6.1	6.75	6.7	6.85	6.85
23	4.4	4.2	5.8	......	13.4	14.35	8.55	6.3	7.2	6.7	6.9	6.75
24	4.3	4.2	5.8	8.8	13.7	13.8	8.35	6.6	7.0	6.65	6.85	6.65
25	4.4	4.3	5.8	8.9	14.2	13.1	8.15	6.2	6.9	6.6	6.85	6.55
26	4.5	4.3	6.5	9.2	14.2	12.4	8.05	6.2	7.0	6.6	......	6.45
27	4.4	4.3	6.4	9.8	14.55	11.85	7.85	......	7.0	6.55	6.85	6.4
28	4.45	4.4	6.3	10.4	14.5	11.6	7.65	6.35	......	6.6	6.9	6.4
29	4.4	......	6.55	10.3	......	11.2	7.55	6.45	7.4	6.75	6.9	6.5
30	4.4	......	7.3	10.0	13.9	10.6	7.55	6.5	7.6	......	6.8	6.55
31	4.3	......	7.75	......	13.4	......	......	......	......	6.75	......	6.5

Daily discharge, in second-feet, of Colorado River at Hardyville, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,430	6,100	6,700	33,600	45,900	83,500	62,600	25,000	15,500	17,800	8,300	7,720
2	3,000	5,600	6,000	36,900	42,900	91,700	59,000	25,000	13,200	16,000	8,000	6,800
3	3,100	5,200	6,000	32,800	41,800	95,500	55,000	29,000	12,500	17,500	8,600	6,700
4	2,900	5,250	5,700	27,300	41,300	94,300	51,000	27,000	13,500	16,800	9,470	6,000
5	2,850	5,110	5,700	27,100	36,400	95,000	50,500	24,400	13,000	16,600	8,900	5,500
6	3,100	5,000	5,650	23,600	34,000	96,500	47,500	21,500	13,000	15,800	9,200	6,000
7	3,440	5,300	5,600	21,100	34,000	94,500	48,700	18,500	12,200	13,500	9,500	10,100
8	3,150	5,300	5,700	21,500	28,500	93,200	47,000	20,700	13,600	12,800	9,500	23,100
9	3,050	5,700	5,650	21,300	35,600	91,200	47,500	18,800	13,600	12,100	10,000	14,500
10	3,300	6,100	5,600	22,100	42,500	92,000	44,100	19,100	13,600	11,700	12,800	13,000
11	3,200	6,200	5,700	22,800	52,700	93,200	41,000	20,500	12,000	12,000	12,700	12,600
12	3,250	6,400	5,800	22,900	58,500	95,800	39,600	17,800	12,600	12,300	12,500	12,400
13	3,200	6,200	6,700	27,000	65,800	91,000	39,000	18,000	12,100	12,000	12,200	11,700
14	3,500	6,200	7,500	26,100	72,800	100,000	34,500	17,500	12,100	12,000	11,300	11,300
15	3,450	6,000	10,600	24,600	71,500	100,000	34,600	17,200	12,100	11,700	10,700	11,300
16	3,700	6,050	15,000	25,200	77,100	101,000	33,500	17,300	11,700	11,100	10,600	10,100
17	4,500	6,100	19,300	25,700	78,000	105,000	36,000	17,600	11,300	10,800	10,300	9,100
18	4,800	5,900	19,000	27,200	72,300	110,000	35,700	16,200	12,000	10,300	10,200	9,100
19	5,200	5,800	15,400	27,200	68,000	115,000	36,500	16,500	15,000	10,200	9,600	9,000
20	5,700	5,600	14,300	27,300	63,700	116,000	37,200	14,000	12,500	9,840	9,200	9,000
21	5,900	5,850	14,900	30,200	68,500	113,000	39,700	13,500	10,800	9,800	9,000	9,000
22	7,300	5,900	14,300	32,200	73,500	113,000	38,500	12,500	11,800	9,300	9,200	8,900
23	7,000	6,000	13,500	34,100	81,000	106,000	38,000	15,000	16,500	9,200	9,400	8,300
24	6,700	6,050	13,200	37,100	83,000	100,000	35,700	20,300	14,000	8,900	9,430	7,600
25	7,200	6,350	12,800	38,300	89,500	93,000	33,600	14,200	12,500	8,500	9,200	7,000
26	7,700	6,300	18,000	41,700	89,500	85,000	32,600	14,000	13,000	8,450	9,200	6,700
27	7,300	6,300	17,600	48,600	92,200	79,700	30,500	14,100	13,000	8,200	9,200	6,400
28	7,700	6,700	17,200	55,600	93,000	76,700	28,500	15,000	15,000	8,400	9,500	6,400
29	7,200	......	22,300	54,500	91,000	72,500	27,000	16,500	17,400	9,400	9,500	7,160
30	7,100	......	26,800	51,200	89,000	66,000	27,500	16,500	19,500	9,400	8,800	7,400
31	6,700	......	31,800	......	84,500	......	27,500	16,500	......	9,400	......	7,100

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Colorado River at Hardyville, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	7,700	2,850	4,830	297,000
February	6,700	5,000	5,880	327,000
March	31,800	5,600	12,300	756,000
April	55,600	21,100	31,600	1,880,000
May	93,000	28,500	64,500	3,970,000
June	116,000	66,000	95,300	5,670,000
July	62,600	27,500	40,000	2,460,000
August	29,000	12,500	18,400	1,130,000
September	19,500	10,800	13,400	797,000
October	17,800	8,200	11,700	719,000
November	12,800	8,000	9,870	587,000
December	23,100	5,500	9,260	569,000
The year	116,000	2,850	26,400	19,200,000

NOTE.—The above values are good.

SAN JUAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

San Juan River rises among the snow masses that crown the high peaks of the San Juan Mountains in southwestern Colorado, flows southwestward into New Mexico, then swings to the west and northwest, passing from San Juan County, N. Mex., across the extreme southwestern corner of Colorado into San Juan County, Utah, in the southwestern part of which it unites with the Colorado.

For the first 75 miles of its course the San Juan is a typical mountain stream, but at Canyon Largo, N. Mex., where it turns westward, its character changes, and it occupies a broad, winding, sandy channel in an arid valley, bordered on each side by terraced mesas. Below the mouth of Mancos River the valley narrows and the river bottom is bounded by abrupt bluffs, broken and cut by dry water channels, and merging farther on into the walls of a deep, narrow, box canyon in which the river flows to its end.

The drainage area includes portions of four States and Territories. Its topography ranges in type from mountainous at the headwaters in Colorado to the types exemplified in the valleys, plateaus, and eroded mesas of Utah, New Mexico, and Arizona. Large areas of eruptive rocks occur in the highest portions of the basin, but the predominating formations are of sedimentary origin. The headwater streams are protected by fine forests of spruce and yellow pine and, at lower elevations, large areas of aspen. The lower basin is practically barren except for an extensive growth of sagebrush, scattered cedars, piñons, and range grasses.

The principal tributaries of the San Juan are Navajo, Piedra, Pine, Florida, Animas, and La Plata rivers, the Animas being the most important.

Animas River has its source in the region above Silverton, draining portions of the Needle and La Plata mountains, the former being the most rugged of the Rocky Mountain ranges. The river flows southward to the Colorado-New Mexico line and thence southwestward to the point where it joins the San Juan at Farmington, N. Mex. The upper portion of the basin, above Durango, is very mountainous and furnishes the greater part of the run-off. This region is generally well timbered with pine, spruce, and aspen, but large areas consist of naked granite peaks. Immediately above and below Durango the valley broadens and is bordered by mesas and bluffs cut by narrow canyons and covered with sagebrush and scattered pines and piñons; along the stream channels cottonwoods predominate. The rocks of this region are chiefly of sedimentary origin. The soils of the lower valleys consist of sandy loam and are very fertile.

La Plata River rises in the granite masses known as La Plata Mountains, about 25 miles northwest of Durango, Colo., and flows southward to its point of junction with the San Juan. Its drainage basin is a narrow strip parallel to and adjoining the Animas basin. The upper portion of the basin is a well-watered and forest-clad mountain region which merges southward into an arid mesa, plateau, and canyon country. La Plata Valley proper is a narrow, shallow depression from Hesperus down, bounded on both sides by high, broken table-lands and deeply eroded mountains. The lower mountain slopes are covered with piñon, scrub oak, and cedar; the lower valleys support heavy growths of sagebrush and chico; the upper mountain slopes were at one time heavily timbered with spruce and yellow and white pine, but these forests have been largely removed by lumbermen.

The other tributaries of the San Juan need not here be described. Those mentioned are perennial streams but much of their water is diverted for irrigation and never reaches the main river. In addition to the perennial streams are many intermittent creeks throughout New Mexico which contribute large volumes of water during heavy storms.

Much land is now under cultivation along the valleys of the San Juan, Animas, Pine, Florida, and La Plata rivers and the smaller tributaries in Colorado. Numerous small lakes high up in the mountains tend to equalize the flow of some of the tributaries, and many large and small storage-reservoir sites are available which will in time be developed. One large power plant has been constructed in this basin and others are contemplated. The largest deposits of lignite and bituminous and coking coal to be found in the West are in this drainage area.

SAN JUAN RIVER NEAR FARMINGTON, N. MEX.

This station was established June 18, 1904, and discontinued September 22, 1906. It was first located near the Methodist Indian school about 3 miles south of Farmington, N. Mex., and about 2 miles below the mouth of Animas River. On May 11, 1906, it was removed to the new suspension bridge, which replaces the old one, about 1½ miles above the original location.

Measurements are made from the bridge; the initial point for soundings is the inside face of the south pier.

The new gage, which was read during 1906 by Samuel Thomalson, consists of a cantilever arm, to which a standard chain gage is attached; length of chain, 6.80 feet. The bench mark is a 20-penny spike driven horizontally into a crevice in the sandstone ledge about 30 feet upstream from the gage; elevation, 9.61 feet above the datum of the gage.

Discharge Measurements of San Juan River near Farmington, N. Mex., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.		Discharge.
				Old gage.	New gage.	
		Feet.	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
May 11	M. C. Hinderlider	235	1,370	9.70	4.45	11,700
June 4	do	235	1,230	8.70	4.40	9,000
June 8	do	235	1,480	10.20	5.80	12,800

Daily gage height, in feet, of San Juan River near Farmington, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	4.15	4.30	4.85	5.65	6.15	4.75	3.75	2.45	1.50
2	4.10	4.38	4.75	5.78	6.00	5.05	3.80	2.40	1.40
3	4.05	4.48	4.80	5.45	6.05	5.10	3.65	2.30	1.30
4	4.00	4.50	4.75	5.20	6.10	4.60	3.90	2.20	1.30
5	3.95	4.50	4.75	5.30	6.45	4.55	3.85	2.20	1.25
6	3.95	4.52	4.75	5.45	6.90	5.35	3.45	2.10	1.30
7	4.18	4.55	4.82	5.65	7.30	5.85	3.45	2.00	1.20
8	4.30	4.58	4.72	7.10	7.75	5.75	3.35	2.05	1.10
9	4.18	4.60	4.82	6.30	8.25	5.60	3.25	2.00	1.10
10	4.28	4.60	4.88	6.25	8.35	6.15	3.20	1.90	1.20
11	4.20	4.58	4.88	6.65	4.50	7.00	3.15	1.80	1.20
12	4.30	4.60	5.12	7.35	4.70	7.10	3.20	1.65	1.15
13	4.30	4.65	5.10	6.65	4.75	7.20	3.10	1.60	1.10
14	4.32	4.70	5.25	6.75	4.05	7.25	3.25	1.55	1.00
15	4.28	4.65	5.10	6.85	3.60	6.65	3.30	1.60	1.10
16	4.22	4.68	5.15	7.40	3.90	6.50	3.20	1.40	2.10
17	4.25	4.65	5.15	7.20	4.40	6.45	3.00	1.40	2.35
18	4.25	4.72	5.10	7.30	4.95	6.25	2.95	1.40	2.05
19	4.28	4.72	5.05	7.55	5.50	5.60	2.75	1.40	1.85
20	4.32	4.70	5.00	7.55	5.85	5.25	2.65	1.40	1.90
21	4.10	4.72	5.05	7.35	6.35	5.30	2.55	1.60	1.90
22	4.05	4.70	5.10	7.90	6.40	4.60	2.50	2.30	1.90
23	4.15	4.75	5.45	8.70	6.45	4.60	2.55	2.00	....
24	4.10	4.70	5.45	7.90	6.20	4.25	2.50	2.30	....
25	4.15	4.72	5.70	7.80	5.55	4.10	2.55	1.90	....
26	4.25	4.75	7.05	7.10	4.85	4.05	2.55	1.65	....
27	4.30	4.85	6.35	7.05	4.35	3.85	2.50	1.50	....
28	4.20	4.75	6.10	7.10	4.45	3.65	2.70	1.40	....
29	4.30	....	5.70	6.80	5.00	3.60	3.20	1.40	....
30	4.32	....	5.25	6.50	5.00	3.50	3.10	1.40	....
31	4.25	....	5.40	....	4.70	....	2.60	1.60	....

NOTE.—Gage heights before May 11 refer to the old gage; those of May 11 and after refer to the new gage established on that date.

LA PLATA RIVER AT HESPERUS, COLO.

This station was established June 14, 1904, in connection with investigations relating to the La Plata project in New Mexico, and discontinued August 18, 1906. It was located at the highway bridge on the west side of Hesperus, Colo. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 140, where are given also references to publications that contain data for previous years.

Discharge measurements of La Plata River at Hesperus, Colo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 6	M. C. Hinderlider	29	62	2.80	350
June 6	do	29	59	2.70	310
June 8	A. Puetz	29	56	2.60	298
June 11	do	29	67	2.90	349
June 18	do	29	52	2.40	235
June 22	do	29	43	2.30	197
June 28	do	29	30	1.90	90
July 9	do	29	23	1.80	64

Daily gage height, in feet, of La Plata River at Hesperus, Colo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	0.95	0.85	0.95	1.25	1.85	2.15	1.80	1.20
2	1.00	0.82	0.92	1.05	1.95	2.05	1.72	1.20
3	1.10	0.80	1.02	1.22	2.00	2.00	1.75	1.20
4	1.00	0.82	0.98	0.98	2.20	2.00	1.90	1.20
5	0.90	0.78	0.95	1.25	2.45	1.98	1.90	1.20
6	0.90	0.80	0.95	1.50	3.25	2.65	2.00	1.20
7	0.82	0.80	0.95	1.20	3.80	2.70	2.00	1.20
8	0.80	0.80	0.95	1.18	3.35	2.80	1.90	1.20
9	1.20	0.80	0.98	1.20	3.80	3.05	1.80	1.10
10	1.00	0.80	0.95	1.22	3.00	3.15	1.80	1.10
11	0.90	0.85	0.98	1.25	2.85	3.10	1.70	1.10
12	0.50	0.85	0.95	1.32	3.15	3.00	1.65	1.00
13	0.42	0.88	0.95	1.42	2.40	3.10	1.60	1.00
14	0.40	0.88	0.95	1.62	2.05	3.00	1.60	1.00
15	0.45	0.88	0.95	2.05	2.05	3.05	1.80	1.00
16	0.42	0.92	0.98	2.00	2.25	2.95	1.80	1.00
17	0.42	0.92	0.95	2.15	2.90	2.65	1.58	1.00
18	0.38	0.92	0.95	2.25	3.00	2.45	1.52	1.00
19	0.40	1.05	0.95	2.02	3.00	2.40	1.50	....
20	0.40	1.10	0.98	2.05	3.05	2.35	1.40	....
21	0.40	1.15	0.98	2.28	3.00	2.10	1.35	....
22	0.42	0.95	1.05	2.80	2.90	2.00	1.30	....
23	0.42	0.90	1.05	2.90	2.55	2.00	1.30	....
24	0.45	0.88	1.00	2.75	2.05	2.20	1.30	....
25	0.48	0.92	1.00	2.20	2.00	2.30	1.30	....
26	0.52	0.95	1.05	2.10	2.00	3.02	1.30	....
27	0.70	0.95	1.05	2.05	2.00	2.25	1.30	....
28	0.72	0.95	0.98	2.05	2.25	1.85	1.32	....
29	0.80	....	1.00	2.00	2.25	1.98	1.35	....
30	0.72	....	1.08	1.98	2.32	1.85	1.32	....
31	0.82	....	1.02	....	2.35	....	1.30	....

LA PLATA RIVER NEAR LA PLATA, N. MEX.

This station was established June 1, 1905, in connection with investigations relating to the La Plata project, and discontinued Sept. 24, 1906. It was located on the single-span wooden highway bridge 1 mile southeast of La Plata post-office, N. Mex., in sec. 3, T. 31, R. 13 W., below all points of diversion. After June 4, 1906, gage heights were found by measuring down from a reference point on the floor of the bridge by a rod graduated to read the height directly. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 142.

Discharge measurements of La Plata River near La Plata, N. Mex., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 9	M. C. Hinderlider	35	70	3.28	352
May 10	do	34	66	3.20	338
June 3	do	33	50	2.62	203

Daily gage height, in feet, of La Plata River near La Plata, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	1.20	2.00	0.75	2.10	2.45	2.58	1.15	1.15	1.10
2	1.20	2.10	0.55	2.05	2.35	2.70	1.15	1.15	1.05
3	1.20	1.65	0.55	2.00	2.25	2.55	1.10	1.15	1.05
4	....	1.10	0.70	2.00	2.40	2.52	1.15	1.15	1.05
5	....	1.80	0.70	2.00	2.70	2.60	1.10	2.58	1.05
6	....	0.95	0.65	2.10	2.55	2.80	1.10	1.25	1.05
7	1.30	1.10	0.60	2.35	3.05	3.00	1.10	1.15	1.05
8	1.30	1.00	0.65	2.25	3.05	2.85	1.12	1.12	1.05
9	1.30	0.80	0.75	2.55	3.25	2.85	1.15	1.10	1.05
10	1.30	0.65	0.95	2.55	3.08	2.88	1.15	1.10	1.05
11	1.30	0.75	1.15	2.55	3.10	2.85	1.15	1.12	1.05
12	1.30	0.80	0.95	2.35	3.02	2.82	1.15	1.15	1.05
13	1.30	0.85	0.95	2.35	2.95	2.85	1.15	1.15	1.05
14	1.30	0.85	0.95	2.40	2.70	2.85	1.80	1.10	1.15
15	1.30	0.85	1.20	2.40	2.50	2.80	1.32	1.10	2.15
16	1.30	0.75	1.25	2.65	2.62	2.65	1.20	1.10	2.20
17	1.30	0.85	0.95	2.70	2.68	2.72	2.60	1.10	1.40
18	1.30	0.70	0.85	3.20	3.05	2.50	1.62	1.10	1.20
19	1.30	0.90	0.75	2.75	3.40	2.35	1.30	1.10	1.15
20	1.30	0.85	0.70	2.70	3.48	2.25	1.18	1.30	1.15
21	....	0.75	0.75	2.95	3.32	2.05	1.15	1.65	1.10
22	....	0.70	0.95	3.20	3.42	2.00	1.15	1.15	1.10
23	....	0.70	1.05	3.10	3.20	2.00	1.10	1.10	1.10
24	....	0.65	1.20	3.05	3.00	1.88	1.10	1.10	1.10
25	....	0.55	2.65	2.95	2.85	1.55	1.10	1.10	....
26	....	0.50	2.40	2.80	2.62	1.25	1.10	1.10	....
27	....	0.50	2.45	2.70	2.45	1.18	1.10	1.10	....
28	1.60	0.75	2.20	2.60	2.55	1.12	1.10	1.10	....
29	1.75	....	2.25	2.55	2.62	1.15	1.10	1.10	....
30	1.70	....	2.20	2.60	2.62	1.15	1.10	1.10	....
31	1.75	....	2.15	....	2.60	....	1.15	1.10	....

LITTLE COLORADO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The country drained by the Little Colorado River consists of a high plateau with an elevation over 4,000 feet above sea level, extending from the Continental Divide in northwestern New Mexico westward to the San Francisco Mountains in Arizona, and from the Grand Canyon of the Colorado southward to the Mogollon Mesa. The greater part of this plateau is composed of rolling plains with a few feet of soil at the surface underlain by rock. Through this plateau the river winds northwestward to its junction with the great Colorado.

The run-off from approximately 6,000 square miles of the drainage area finds its way into the Little Colorado above the mouth of Rio Puerco, the largest tributary which joins the main stream 2 miles above the town of Holbrook, Ariz. Both the Little Colorado and the Rio Puerco are flashy streams, seldom clear even during low stages. They have shifting, sandy bottoms, and when not confined in canyons the stream beds are wide with abrupt earth banks. The discharge fluctuates greatly, being insignificant in dry seasons. The floods are short and violent and carry large quantities of silt in suspension.

LITTLE COLORADO RIVER AT WOODRUFF, ARIZ.

This station was established March 16, 1905. It is located about 100 yards below the crossing of the Holbrook-Winslow wagon road and one-fourth mile below the Woodruff dam. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 145.

The station equipment which was carried away by the flood of November 26 and 27, 1905, was replaced March 24, 1906. A new cable 210 feet long, car, and tag wire were erected, also a combined vertical and inclined rod was placed in the same location as the old one.

The bench marks previously used were replaced by the following: Bench mark No. 1 is the head of a bolt in a scar in a tree, to which the second inclined section is fastened; elevation, 14.92 feet. Bench mark No. 2 is the head of a bolt in a scar on the river side of the fifth cottonwood tree south in a row, to which the last section of the gage rod is fastened; elevation, 23.02 feet. Elevations refer to the datum of the gage.

Discharge measurements of Little Colorado River at Woodruff, Ariz., by R. L. Newman, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 3	0.3	25	June 29[b]		4.2
January 4	.3	26	July 3		4.3
January 5	.3	25	July 6		6.4
January 16	4.75	395	July 12		6.3
January 17	5.0	444	July 13		5.7
January 18	3.5	184	July 16		7.0
January 23	1.3	124	July 18		14
January 24	1.0	106	July 20		21
January 25	.9	106	July 23[b]		19
January 29	1.0	108	July 24	2.0	19
January 31	.7	107	July 26	3.0	228
February 1	.5	86	July 27	2.0	24
February 2	.9	128	July 31	1.5	2.6
February 5	1.35	186	August 1	1.5	2.7
February 6	1.2	187	August 3	2.2	49
February 8	1.7	262	August 6	1.6	4.2
February 9	1.8	254	August 7	1.6	3.4
February 12	1.7	260	August 9	2.6	165
February 14	1.2	199	August 10	2.0	50
February 15	1.0	144	August 13	2.2	39
February 16	.9	141	August 20	3.5	501
February 19	.9	145	August 23	1.3	66
February 21	.8	129	August 24	2.4	67
February 22	.9	146	August 27	1.9	37
February 23	.9	151	August 28	1.8	28
February 26	.7	134	August 30	1.4	18
February 28	.6	127	August 31	1.4	23
March 1	.6	150	September 2[c]	1.4	6.9
March 2	.5	143	September 4	1.3	5.7
March 5	.5	143	September 6	1.3	2.4
March 6	.6	140	September 7	1.2	2.1
March 8	.5	72	September 10	1.0	1.1
March 9	.5	83	September 11	1.0	.7
March 14	8.85	1,620	September 13	.9	.5
March 15	5.5	786	September 17	.9	.5
March 20	2.7	290	September 18	.9	.5
March 23	1.7	150	September 20	.9	.5
March 26	5.3	1,110	September 21	.9	.5
March 28	4.3	663	September 24	.9	.6
March 29	3.9	539	September 25	1.0	1.3
March 30	3.7	552	September 26	1.0	1.3
April 3	2.2	223	September 27	1.9	43
April 4	2.2	221	September 30	2.8	166
April 6	2.1	213	October 1	2.3	98
April 8	5.45	808	October 3	1.4	17
April 10	3.5	517	October 5	1.3	14
April 12	2.2	256	October 7	1.3	13
April 16	2.5	266	October 9	1.2	12
April 18	2.5	317	October 11	1.2	9.0
April 23	2.7	371	October 19	1.1	7.6
April 24	2.7	376	October 22	1.2	11
April 27	2.6	367	October 24	1.3	8.8
April 29	2.6	191	October 26	1.2	4.6
April 30	2.6	174	October 28	1.2	5.0
May 2	2.4	141	October 31	1.2	3.9
May 4	2.3	130	November 1	1.3	5.3
May 7	2.1	140	November 2	1.2	3.8
May 9[a]	2.25	82	November 5	1.2	6.4
May 14	1.8	20	November 7	1.2	5.5
May 15	1.8	21	November 9	1.3	6.6
May 18	1.6	13	November 11	1.2	8.3
May 21	1.4	8	November 12	1.2	7.5
May 22	1.4	10	November 15	1.2	7.4
May 23	1.4	9	November 18	1.2	7.7
May 24	1.4	9	November 23[b]		6.9
May 25	1.4	9	November 26	1.85	18
May 28	1.4	9	November 27	1.5	12
May 29	1.4	10	November 29[b]	1.3	5.7
May 30	1.4	5	December 1	7.95	1,980
June 4	1.4	4	December 5	.65	571
June 6	1.4	4	December 12	.9	119
June 7	1.4	4	December 14	.9	103
June 8	1.4	3	December 17	.7	79
June 12[b]		4	December 20	.4	44
June 14[b]		4	December 23	2	23
June 18[b]		4	December 26	2	22
June 22[b]		4.3	December 30	5	130
June 25[b]		4.2			

[a] Measurement made by H. S. Reed. [b] Measured at different section. [c] Irrigation ditch running full.

Daily gage height, in feet, of Little Colorado River at Woodruff, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.3	0.5	0.65	2.6	2.3	1.4	......	1.5	1.3	2.3	1.25	1.3
2	.2	.85	.5	2.05	2.3	1.4	......	2.5	1.4	1.65	1.25	1.4
3	.25	1.15	.5	2.2	2.3	1.4	......	1.75	1.35	1.45	1.2	2.25
4	.3	1.2	.5	2.2	2.3	1.4	......	1.7	1.3	1.4	1.2	8.1
5	.3	1.35	.5	2.2	2.15	1.4	......	1.7	1.3	1.3	1.2	3.7
6	.3	1.05	.5	2.1	2.0	1.4	......	1.6	1.3	1.2	1.2	2.9
7	.3	1.7	.5	3.2	2.1	1.4	......	1.6	1.2	1.25	1.2	2.55
8	.3	1.85	.5	5.25	2.15	1.4	......	1.95	1.15	1.25	1.3	1.9
9	.3	1.85	.5	4.5	2.25	1.4	......	2.65	1.1	1.2	1.25	1.7
10	.3	1.65	.5	3.25	2.2	1.4	......	2.2	1.0	1.2	1.15	1.15
11	.3	1.4	.4	2.8	2.05	1.4	......	1.95	1.0	1.2	1.1	.9
12	.3	1.55	.45	2.5	1.85	1.4	......	2.2	1.0	1.0	1.2	.9
13	.3	1.7	12.5	2.25	1.8	1.4	......	2.15	.9	1.0	1.2	.9
14	.3	1.2	9.15	2.35	1.8	1.1	......	2.25	.9	1.1	1.2	.9
15	1.9	1.0	5.0	2.6	1.8	1.4	......	2.1	.9	1.05	1.2	.9
16	4.5	.9	3.85	2.45	1.75	1.25	......	2.3	.9	1.0	1.2	.9
17	4.0	.7	3.4	2.5	1.65	1.1	......	2.3	.9	1.05	1.2	.75
18	4.1	.85	2.95	2.5	1.55	1.1	......	2.25	.9	1.0	1.2	.6
19	4.15	.9	3.4	2.45	1.4	1.1	......	2.2	.9	1.1	1.1	.5
20	2.95	.8	2.75	2.5	1.4	1.0	......	2.75	.9	1.05	1.2	.45
21	2.4	.8	2.15	2.4	1.4	1.45	2.0	2.55	.9	1.2	1.2	.2
22	1.75	.9	1.9	2.4	1.4	.7	1.95	2.35	0.9	1.2	1.15	.2
23	1.2	.9	1.7	2.65	1.4	(a)	2.0	1.3	.9	1.2	1.15	.2
24	1.0	.9	1.85	2.65	1.4	......	1.9	1.9	.9	1.25	1.2	.2
25	.95	.8	1.9	2.7	1.4	......	1.5	1.65	.95	1.2	1.2	.2
26	1.05	.7	4.55	2.6	1.4	......	2.75	1.45	.95	1.2	1.45	.2
27	1.05	.65	7.0	2.65	1.4	......	2.05	1.65	1.5	1.2	1.55	.25
28	.95	.6	4.75	2.6	1.4	......	1.6	1.65	2.15	1.2	1.3	.35
29	.95	......	4.1	2.65	1.4	......	1.7	1.35	2.45	1.15	1.3	3.05
30	.65	......	3.6	2.55	1.4	......	1.0	1.4	2.9	1.2	1.3	3.45
31	.7	......	2.85	......	1.4	......	1.5	1.3	......	1.2	......	2.2

[a] Water filling reservoir, June 23 to July 21.

Daily discharge, in second-feet, of Little Colorado River at Woodruff, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	25	86	153	300	141	4	4	3	15	85	5	7
2	22	124	143	186	135	4	4	100	7	30	4	9
3	23	159	142	223	133	4	4	27	6	18	4	33
4	25	165	141	221	130	4	5	24	6	16	5	2,070
5	25	186	140	226	120	4	6	24	4	14	6	590
6	25	167	117	200	100	4	6	19	2	10	5	435
7	25	275	92	407	140	4	6	19	2	12	6	370
8	25	310	72	786	150	4	6	40	2	12	6	220
9	25	265	85	660	167	3	6	127	2	10	6	206
10	25	235	85	453	160	4	6	60	1	10	7	145
11	25	202	80	378	105	4	6	40	1	10	8	110
12	25	233	82	325	50	4	6	60	1	7	8	119
13	25	270	2,285	254	30	4	6	39	1	7	8	110
14	25	200	1,672	281	20	4	6	65	1	8	7	103
15	79	144	700	325	21	4	6	50	1	7	7	110
16	345	141	495	282	18	4	7	70	1	7	7	110
17	257	118	418	297	15	4	10	70	1	7	7	90
18	275	135	338	302	12	4	14	65	1	7	7	70
19	283	145	415	291	9	4	17	60	1	8	7	55
20	158	133	300	304	9	4	21	151	1	7	7	52
21	141	129	215	260	8	4	20	311	1	10	7	22
22	128	146	178	254	10	4	19	281	1	10	7	22
23	118	151	150	356	9	4	19	70	1	10	7	22
24	106	153	175	358	9	4	19	67	1	8	7	22
25	106	145	182	380	9	4	11	57	1	6	7	22
26	111	134	760	350	9	4	176	46	1	5	10	22
27	111	130	1,867	375	9	4	29	37	23	5	11	26
28	106	127	820	225	9	4	6	28	68	5	8	40
29	107	......	601	250	10	4	11	23	105	4	8	364
30	102	......	534	184	5	4	6	18	185	5	7	425
31	107	......	365	......	5	......	2	23	......	4	......	260

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Google

Monthly discharge of Little Colorado River at Woodruff, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	345	22	96.3	5,920
February	310	86	172.	9,550
March	2,280	72	445.	27,400
April	786	184	323.	19,200
May	167	5	56.7	3,490
June	4	3	4.0	238
July	176	2	15.2	935
August	311	3	66.9	4,110
September	185	1	14.8	881
October	85	4	11.7	719
November	11	4	6.9	411
December	2,070	7	202.	12,400
The year	2,280	1	118.	85,200

LITTLE COLORADO RIVER AT HOLBROOK, ARIZ.

This station was established March 17, 1905. It is located at the county bridge across Little Colorado River at Holbrook, Ariz. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 149.

Discharge measurements of Little Colorado River at Holbrook, Ariz., by Newman and Reed, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 17	3.95	932	May 3	5.0	148
January 19	3.6	848	May 6	4.9	100
January 22	3.7	418	May 10	4.9	84
January 24	3.6	420	May 14	4.7	47
January 26	3.4	187	May 20	4.5	23
January 28	3.6	192	May 22	4.5	10
January 30	3.6	173	May 24	4.4	12
February 1	3.7	177	May 27	4.4	10
February 4	3.8	145	June 3	4.4	4
February 7	4.2	282	June 6	4.4	5
February 10	4.0	204	June 10	4.4	6
February 11	4.0	194	June 17	4.3	5
February 13	3.8	144	June 24	4.3	3.4
February 16	3.9	122	July 1	4.3	2.6
February 20	4.05	161	Do	4.3	3.7
February 22	4.0	93	July 14	4.3	4.2
February 25	3.9	86	July 15	4.9	64
February 27	3.7	75	July 17	4.3	10
March 6[a]	3.9	66	July 22	4.7	64
March 11[a]	3.8	65	July 28	4.6	29
March 13	6.85	3,860	August 5	4.8	19
March 22	4.2	196	August 12	4.4	36
Do	4.2	200	August 17	4.7	54
March 25	4.3	206	August 22	4.5	185
March 27	5.8	2,900	August 25	4.9	65
March 29	5.2	1,310	August 28	4.4	20
April 2	4.8	272	August 30	4.5	137
Do	4.8	268	September 2	4.3	40
April 4	4.75	292	September 9	4.2	7.6
April 8	5.8	1,510	September 15	4.0	2.5
April 10	5.7	298	September 17[a]	.	4.8
April 12	5.5	308	September 21[a]	.	4.4
April 14	5.4	326	September 24[a]	.	4.7
April 17	5.4	211	September 28[a]	6.75	847
April 19	5.3	329	September 29	5.0	417
April 21	5.4	405	October 4	4.4	87
April 26	5.4	445	October 6	3.4	12
April 28	5.0	251	October 8[b]	......	6.2
May 1	5.2	150	October 12[b]	......	8.8
			October 21[b]	......	8.6

[a] Measured at different section.

[b] Measurement made at different section.

Discharge measurements of Little Colorado River at Holbrook, Ariz., by Newman and Reed, in 1906—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
October 28[a]		8.2	December 3	5.0	149
October 29[a]		7.9	December 4	7.15	1,120
October 31[a]		4.6	December 6	4.8	307
November 2[a]		4.2	December 9	4.7	281
November 5[a]		4.2	December 13	4.6	47
November 9[a]		5.1	December 14	4.5	42
November 13[a]		5.1	December 16	4.4	34
November 20[a]		5.4	December 19	4.5	31
November 24[a]		10	December 23	4.5	22
November 27	4.8	63	December 29		1,080
November 30	4.3	25			

[a] Measurements made at different sections.

Daily gage height, in feet, of Little Colorado River at Holbrook, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.45	3.8	3.9	4.78	4.9	4.4	4.3	4.6	5.45	4.7	4.0	4.3
2	3.5	3.8	4.0	4.8	4.95	4.4	4.3	5.15	4.65	4.55	4.0	4.3
3	3.5	3.8	4.0	4.7	5.0	4.4	4.3	4.8	4.5	4.35	4.0	5.7
4	3.5	3.8	4.0	4.8	5.05	4.4	4.3	4.8	4.35	4.2	4.0	6.65
5	3.5	3.8	3.9	4.75	5.0	4.4	4.3	4.75	4.2	4.2	4.0	5.15
6	3.5	4.0	4.0	4.78	4.95	4.4	4.3	4.6	4.2	4.2	4.0	4.7
7	3.7	4.1	4.1	5.35	4.9	4.4	4.3	5.45	4.2	4.2	4.0	4.7
8	3.0	4.1	4.0	5.72	4.9	4.4	4.3	4.5	4.2	4.2	4.0	4.7
9	3.6	4.35	3.9	5.15	4.9	4.4	4.3	4.55	4.2	4.2	4.0	4.7
10	3.6	4.1	3.9	5.3	4.9	4.4	4.3	4.5	4.2	4.2	4.0	4.7
11	3.6	4.0	3.9	5.05	4.9	4.4	4.3	4.6	4.2	4.15	4.0	4.7
12	3.6	4.0	3.9	5.0	4.9	4.4	4.3	4.5	4.2	4.0	4.0	4.65
13	3.6	4.2	6.6	5.1	4.85	4.3	4.3	4.4	4.2	4.0	4.0	4.6
14	3.7	4.2	5.5	5.15	4.0	4.3	4.3	4.35	4.2	4.0	4.0	4.6
15	3.7	4.2	4.45	5.2	4.7	4.2	4.3	4.3	4.2	4.0	4.0	4.6
16	5.6	4.1	4.35	5.2	4.7	4.2	4.3	4.3	4.2	4.0	4.0	4.55
17	3.9	4.0	4.3	5.1	4.7	4.2	4.3	4.3	4.2	4.0	4.0	4.5
18	3.8	3.9	4.4	5.1	4.0	4.2	4.3	4.3	4.2	4.0	4.0	4.5
19	3.6	3.9	4.5	5.0	4.0	4.2	4.3	4.25	4.2	4.0	4.0	4.4
20	3.0	4.0	4.6	5.0	4.6	4.2	4.3	4.2	4.2	4.0	4.0	4.4
21	4.0	4.0	4.0	5.15	4.5	4.2	4.3	4.4	4.2	4.0	4.0	4.4
22	3.85	4.0	4.3	5.1	4.5	4.2	4.7	4.4	4.2	3.95	4.0	4.4
23	3.7	4.0	4.3	5.3	4.5	4.2	5.1	5.0	4.2	3.85	4.0	4.4
24	3.7	4.1	4.3	5.2	4.45	4.3	4.95	4.9	4.2	3.8	4.0	4.4
25	3.6	4.0	4.4	5.2	4.4	4.3	4.7	4.9	4.2	3.7	4.3	4.4
26	3.6	4.0	5.02	5.2	4.4	4.3	5.2	4.9	4.2	3.65	4.5	4.4
27	3.6	3.92	6.0	5.1	4.4	4.3	5.0	4.75	4.2	3.6	4.8	4.5
28	3.62	3.85	5.25	5.0	4.4	4.3	4.7	4.0	6.0	3.5	4.5	4.4
29	3.72		5.15	5.0	4.4	4.3	4.6	5.2	5.3	3.5	4.4	6.2
30	3.8		4.95	4.9	4.45	4.3	4.6	5.2	5.15	3.5	4.4	0.05
31	3.8		4.75		4.4		4.6	5.45		4.0		5.85

Daily discharge, in second-feet, of Little Colorado River at Holbrook, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	305	194	75	250	90	5	3	20	445	250	4	25
2	330	130	75	270	115	5	3	80	75	170	4	25
3	330	135	75	250	150	5	3	25	60	83	4	460
4	330	140	75	330	150	5	3	25	40	72	4	890
5	330	145	66	290	125	5	3	15	20	30	4	215
6	330	213	75	300	105	5	3	15	17	12	4	255
7	420	245	75	987	97	5	3	145	15	9	4	260
8	370	243	75	925	93	5	3	67	12	6	5	270
9	370	325	100	115	88	5	3	20	10	7	5	235
10	370	240	175	145	84	5	3	30	7	8	5	235

Daily discharge, in second-feet, of Little Colorado River at Holbrook, Ariz., for 1906—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	370	195	175	105	80	5	3	50	6	10	5	185
12	370	195	175	100	75	5	3	45	5	9	5	120
13	370	272	3,537	140	65	4	3	35	4	9	5	47
14	420	272	2,173	180	35	4	3	30	4	9	5	45
15	420	272	550	180	45	3	3	25	4	9	5	45
16	1,330	250	375	165	45	3	3	25	4	9	5	43
17	920	200	350	130	45	3	3	25	4	9	5	40
18	896	102	450	155	35	3	3	25	4	9	5	40
19	848	90	550	170	35	3	3	23	4	9	5	35
20	848	88	600	160	35	3	3	17	4	9	5	35
21	935	94	150	185	17	3	3	145	4	9	5	35
22	676	93	350	170	10	3	64	145	4	9	7	35
23	423	93	250	250	10	3	134	275	4	8	8	35
24	429	175	200	200	7	4	99	130	4	8	10	35
25	187	97	400	200	5	4	57	65	4	8	28	35
26	187	100	1,340	200	5	4	140	65	4	8	40	35
27	189	93	3,260	215	5	4	95	55	4	8	63	40
28	194	73	1,435	250	5	4	37	44	600	8	34	35
29	165	....	1,182	185	5	4	28	155	370	8	25	680
30	168	....	662	125	7	4	28	155	319	8	25	620
31	168	....	220	....	5	....	28	240	....	5	....	530

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Little Colorado River at Holbrook, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	1,330	165	452	27,800
February	325	73	170	9,440
March	3,540	66	621	38,200
April	987	100	245	14,600
May	150	5	54.0	3,320
June	5	3	4.1	244
July	140	3	24.9	1,530
August	275	15	71.5	4,400
September	600	4	68.7	4,090
October	250	5	26.6	1,640
November	63	4	11.3	672
December	890	25	181	11,100
The year	3,540	3	161	117,000

Summary of observations of evaporation at Holbrook, Ariz., in 1905–6.

Month.	Amount of evaporation.	Temperature of water.					
		In pan.			Outside pan.		
		Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
1905.	*Inches.*						
August [a]	6.60	81	66	73.5	80	66	73.6
September	4.57	79	55	66.4	78	56	66.5
October	4.26	73	41	56.9	73	42	56.8
November	[b] 1.45	59	40	48.1	59	40	48.4
December	0.22	48	29	37.5	48	29	37.8
1906.							
January [c]	0.03	35	32	32.4	36	32	32.7
February	1.24	53	33	41.8	52	34	42.1
March	3.28	64	37	46.4	63	38	46.9
April	5.12	60	42	52.5	68	42	52.7
May	6.93	71	49	60.3	70	50	60.4
June	8.61	79	55	65.6	75	54	65.2
July	7.42	80	61	[d] 70.5	81	62	[d] 71.1
August	6.24	76	63	70.4	76	64	71.0
September	5.12	75	55	65.3	75	56	65.7
October	3.44	69	40	56.0	69	41	56.4
November	1.43	57	40	46.1	58	40	46.7
December	.94	46	39	42.4	47	40	43.1
The year	49.80	80	32		81	32	......

[a] 29½ days. [b] 29 days. [c] For 5 days; the pan was frozen January 5 to 30. [d] 30 days.

LITTLE COLORADO RIVER AT ST. JOHNS, ARIZ.

This station was established April 18, 1906. It is located at the south end of the town of St. Johns, one-half mile above the dam and county bridge.

The channel is straight for 300 feet above and 250 feet below the station. There is a good velocity at all stages, becoming swift at high water. The banks are clean and almost perpendicular, and will not overflow during high water. The bed of the stream is clean, and sandy; it probably shifts slightly. There is one channel at all stages.

Discharge measurements are made by means of a cable, car, and tagged wire. A stay wire is used for high-water measurements. The initial point for soundings is the face of the cable support on the right bank.

The staff gage, which is read by the local hydrographer, W. D. Rencher, is bolted to the framework built out over the bank on the right side of the river at the gaging station. The bench mark is the head of a bolt driven into solid ledge 73 feet northeast from the cable support on the left bank; elevation, 15.43 feet above the zero of the gage.

Discharge measurements of Little Colorado River at St. John, Ariz., by Reed and Rencher, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
April 19	6.23	477	August 20	3.98	28
April 19	6.13	424	August 20	4.84	213
April 24	5.78	338	August 23	4.94	112
April 30	5.06	186	September 10	3.94	9.5
May 4	4.90	132	September 17	3.87	7.7
May 8	4.80	148	September 22	3.88	8.2
May 14	4.20	48	September 28	3.94	13
May 18	4.00	35	October 5	3.91	10
May 23	3.93	23	October 11	3.92	12
May 28	3.90	21	October 17	3.90	9.9
June 2	3.82	16	October 24	3.91	11
June 7	3.79	16	October 30	3.91	12
June 15	3.66	8.0	November 5	3.93	13
June 23	3.74	12	November 12	3.94	15
June 28	3.76	13	November 19	3.95	14
July 4	3.79	16	November 24	4.03	19
July 12	3.85	12	November 28	4.07	23
July 18	3.86	14	December 4 [a]	4.96	206
July 28	4.00	24	December 11	4.60	65
August 3	3.93	19	December 15	4.44	48
August 9	4.04	24	December 22	4.10	23
August 14	3.98	16	December 31 [a]	4.68	61

[a] Float measurement.

Daily gage height, in feet, of Little Colorado River at St. Johns, Ariz., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	5.08	3.84	3.71	4.68	4.29	3.94	3.91	4.09
2	....	4.92	3.82	3.70	4.31	4.16	3.93	3.92	4.11
3	....	4.90	3.82	3.75	3.95	4.09	3.92	3.92	4.13
4	....	4.90	3.82	4.10	3.96	4.05	3.91	3.92	4.61
5	....	4.82	3.81	3.88	3.91	4.02	3.91	3.93	5.80
6	....	4.80	3.80	4.17	3.90	3.99	3.90	3.93	5.72
7	....	4.82	3.79	3.83	3.94	3.97	3.90	3.93	5.10
8	....	4.80	3.79	3.80	4.04	3.95	3.90	3.94	4.84
9	....	4.50	3.78	3.80	4.04	3.94	3.90	3.94	4.78
10	....	4.30	3.74	3.82	4.52	3.93	3.91	3.94	4.74
11	....	4.25	3.70	3.85	4.15	3.91	3.92	3.94	4.62
12	....	4.20	3.67	3.85	4.00	3.90	3.92	3.94	4.55
13	....	4.20	3.66	3.85	3.99	3.89	3.92	3.94	4.50
14	....	4.20	3.66	3.85	3.98	3.89	3.92	3.94	4.50
15	....	4.12	3.65	3.84	3.97	3.88	3.93	3.94	4.45
16	....	4.08	3.65	3.85	4.90	3.88	3.95	3.95	4.29
17	....	4.02	3.65	3.85	4.15	3.87	3.92	3.95	4.20
18	....	4.00	3.65	3.86	3.92	3.87	3.90	3.95	4.13
19	6.18	3.94	3.64	3.88	3.89	3.87	3.91	3.95	4.14
20	6.08	4.00	3.64	3.86	4.39	3.87	3.91	3.96	4.12
21	5.82	3.99	3.64	3.86	5.00	3.87	3.90	3.98	4.11
22	6.10	3.95	3.64	3.86	5.45	3.88	3.91	4.00	4.11
23	5.95	3.93	3.76	4.03	4.70	3.88	3.91	4.02	4.12
24	5.90	3.93	3.79	3.93	4.35	3.88	3.91	4.03	4.14
25	5.68	3.90	3.80	3.86	4.26	3.92	3.90	4.05	4.13
26	5.48	3.90	3.80	4.18	4.25	4.05	3.90	4.07	4.12
27	5.40	3.90	3.78	3.88	4.26	4.03	3.90	4.07	4.12
28	5.30	3.88	3.75	3.95	4.19	3.96	3.90	4.08	4.13
29	5.15	3.87	3.74	3.96	4.20	3.97	3.92	4.05	4.24
30	5.08	3.86	3.70	3.90	4.49	3.98	3.91	4.04	4.40
31	....	3.85	....	3.86	4.36	....	3.91	....	4.69

Daily discharge, in second-feet, of Little Colorado River at St. Johns, Ariz., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	185	18	10	100	46	14	11	23
2	....	145	17	10	53	33	13	12	25
3	....	137	17	13	22	26	12	12	26
4	....	132	17	32	23	21	11	12	69
5	....	130	16	15	18	18	11	13	533
6	....	135	16	38	17	15	10	13	502
7	....	145	15	11	20	13	10	13	260
8	....	148	15	9	28	11	10	14	159
9	....	95	14	9	28	10	10	14	135
10	....	70	12	10	67	9	11	14	120
11	....	60	10	12	32	9	12	14	73
12	....	55	8	12	17	9	12	14	60
13	....	50	8	12	17	8	12	14	54
14	....	48	8	12	16	8	12	14	54
15	....	42	7	12	17	8	13	14	50
16	....	40	7	12	120	8	15	15	37
17	....	37	7	12	38	8	12	15	31
18	....	35	7	13	20	8	10	15	26
19	460	27	7	15	18	8	11	15	27
20	415	32	7	13	85	8	11	16	25
21	340	33	7	13	205	8	10	18	25
22	420	27	7	13	260	8	11	20	25
23	380	23	13	27	80	8	11	22	25
24	370	23	15	19	52	8	11	19	27
25	315	21	16	13	43	12	10	20	26
26	265	21	16	39	42	25	10	22	25
27	250	21	14	15	43	23	10	22	25
28	230	20	13	20	36	16	10	23	26
29	200	19	12	21	37	17	12	20	34
30	190	19	10	16	65	18	11	19	46
31	....	18	....	13	53	....	11	....	100

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Little Colorado River at St. Johns, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 19–30	460	190	320	7,620
May	185	18.0	64.3	3,950
June	18.0	7.0	11.9	708
July	39	9	15.8	972
August	260	16	53.9	3,310
September	46	8	14.2	845
October	15	10	11.3	695
November	23	11	16.0	952
December	533	23	86.2	5,300
The period				24,400

SILVER CREEK AT SNOWFLAKE, ARIZ.

This station was established May 4, 1906. It is located at the southeast end of the town and 2 miles below the dam of Snowflake and Taylor Irrigation Company. All water is shut off by the dam during the entire irrigation season, excepting when rains occur.

The channel is straight for 200 feet above and 150 feet below the station. The current is good at all stages. The right bank is high, sandy, and clean; the left is sandy, is higher than the right and is covered with small willows which serve to hold the soil in place. Owing to the level country and the sudden rains to which this creek is subjected, both banks will probably overflow during extreme high water. The bed of the stream is sandy, level, and clean. There is one channel at all stages, except when the banks overflow and then water is liable to extend over a large area.

Discharge measurements are made by means of a cable and car during high water and by wading at low stages. The initial point for soundings is the first tag wire from the support on the right bank.

The gage, which is read by J. W. Smith twice each day, is a combined vertical and inclined rod on the right bank of the stream at the point of measurement. The bench mark is the head of a bolt in the trunk of a large cottonwood tree 400 feet northeast from the rod; elevation, 16.68 feet above the zero of the gage.

Discharge measurements of Silver Creek at Snowflake, Ariz., by Reed and Newman, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 8	2.2	1.2	August 1	2.0	1.4
May 18	2.2	.9	August 8	2.1	4.5
May 25	2.2	.8	August 16	2.1	3.4
June 1	2.2	1.0	August 21	2.1	3.6
June 14	2.0	.8	August 29	2.1	3.5
June 21	2.0	.6	September 5	2.0	1.6
June 28	2.0	.9	September 12	1.9	.8
July 6	1.9	.5	September 19	1.9	.4
July 12	2.0	1.7	November 11	2.3	1.4
July 20	2.0	2.0	December 11	2.3	5.4
July 25	2.0	1.2			

Daily gage height, in feet, of Silver Creek at Snowflake, Ariz., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	2.05	2.00	2.33	2.20	2.30	2.40	2.20
2	....	2.10	2.00	2.32	2.18	2.28	2.40	2.20
3	....	2.05	2.00	2.12	2.18	2.22	2.42	3.25
4	....	2.05	2.35	2.08	2.15	2.20	2.38	6.00
5	....	2.05	2.03	2.08	2.10	2.20	2.35	4.50
6	2.15	2.05	2.05	2.08	2.12	2.20	2.30	3.80
7	2.15	2.05	2.05	2.08	2.10	2.20	2.28	3.00
8	2.15	2.05	2.05	2.10	2.10	2.18	2.25	2.50
9	2.15	2.00	2.05	2.55	2.08	2.15	2.25	2.38
10	2.15	2.10	2.03	2.25	2.08	2.15	2.38	2.35
11	2.15	2.05	2.00	2.30	2.08	2.30	2.22	2.30
12	2.15	2.10	2.00	2.80	2.02	2.30	2.20	2.30
13	2.15	2.05	2.00	2.42	2.00	2.30	2.25	2.30
14	2.15	2.00	2.00	2.25	1.98	2.30	2.25	2.30
15	2.15	2.00	2.00	2.25	1.95	2.30	2.25	2.25
16	2.15	2.00	2.10	2.45	2.00	2.38	2.25	2.15
17	2.15	2.00	2.20	2.48	2.00	2.32	2.25	2.13
18	2.15	2.00	2.08	2.35	2.00	2.28	2.28	2.08
19	2.15	2.00	2.05	2.22	2.00	2.28	2.30	2.23
20	2.15	2.00	2.03	2.35	2.00	2.28	2.30	2.17
21	2.15	2.00	2.00	2.45	2.00	2.32	2.30	2.17
22	2.15	2.00	2.00	2.40	2.00	2.35	2.30	2.17
23	2.15	2.00	2.03	2.40	2.00	2.32	2.25	2.17
24	2.15	2.00	2.05	2.35	2.00	2.32	2.55	2.17
25	2.15	2.00	2.03	2.25	2.00	2.30	2.70	2.17
26	2.15	2.00	2.00	2.20	2.00	2.22	2.50	2.17
27	2.15	2.00	2.10	2.15	2.00	2.15	2.30	2.20
28	2.15	2.00	2.13	2.15	2.00	2.15	2.25	2.45
29	2.15	2.00	2.05	2.10	3.52	2.18	2.20	4.05
30	2.15	2.00	2.05	2.30	2.52	2.30	2.20	3.70
31	2.15	....	2.05	2.25	....	2.38	....	3.05

Daily discharge, in second-feet, of Silver Creek at Snowflake, Ariz., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	1	1	5	2	2	3	3
2	....	1	1	5	2	2	3	3
3	....	1	1	2	2	2	3	4
4	....	1	6	2	2	2	3	50
5	....	1	1	2	2	2	3	28
6	1	1	1	2	1	2	3	19
7	1	1	1	2	1	2	3	11
8	1	1	1	4.5	1	2	3	8
9	1	1	1	8	1	1.5	3	6
10	1	1	1	4	1	1.5	3	7
11	1	1	1	5	1	2	3	5
12	1	1	2	11	.5	2	2	5
13	1	1	2	1	.5	2	2	5
14	1	1	2	4	.5	2	1.5	5
15	1	1	2	4	.5	2	1.5	5
16	1	1	2	3.5	.5	4	1.5	4
17	1	1	4	3.5	.5	4	1.5	4
18	1	1	3	3	.5	4	3	4
19	1	1	3	3	.5	4	3	5
20	1	1	2	3	.5	4	3	5
21	1	1	2	7	.5	4	3	5
22	1	1	1	6	.5	3	3	5
23	1	1	1	6	.5	3	3	5
24	1	1	1	5	.5	3	4	5
25	1	1	1	4	.5	2	6	5
26	1	1	1	3	.5	2	4	5
27	1	1	1	3	.5	2	3	5
28	1	1	1	3	.5	2	3	6
29	1	1	1	3	20	2	3	22
30	1	1	1	4	8	3	3	18
31	1	....	1	4	....	3	....	11

Note.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Silver Creek at Snowflake, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May (6-31)	1	1	1.0	52
June	1	1	1.0	60
July	6	1	1.6	98
August	11	2	4.0	246
September	20	.5	1.8	107
October	4	1.5	2.5	154
November	6	1.5	2.9	173
December	50	3	9.0	553
The period				1,440

SILVER CREEK AT CANYON STATION NEAR SNOWFLAKE, ARIZ.

This station was established May 2, 1906. It is located at the mouth of Silver Creek canyon just below the town of Snowflake. It was established principally to determine the flood waters of Silver Creek and Cottonwood Wash, which can not be taken care of by the station above. At times Cottonwood Wash carries more water than the main stream.

During the irrigation season the stream is entirely shut off above the Snowflake and Taylor Irrigation Company's dam, 3 miles above. All water passing the section during this period is waste and seepage water.

The channel is straight for 500 feet above and 600 feet below the station. The current is very swift at high water. Both banks are high, are strewn with bowlders, and will not overflow. The bed of the stream at the cable section is of gravel and sand formation. Above and below the cable the bed is covered with cobblestones.

Discharge measurements are made by means of a cable, car, and tagged wire. The initial point for soundings is the first tag on a wire at the right bank.

The gage is a series of inclined rods bolted to solid rock on the right bank of the canyon 100 feet above the gaging section. Bench mark No. 1 is a cross cut into a point of ledge to which the rod is bolted at elevation 26.01 feet above the zero of the gage.

Discharge measurements of Silver Creek at canyon station near Snowflake, Ariz., by Reed and Newman, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
May 4	2.6	5.2	August 29[a]	2.8	19.6
May 9	2.6	2.7	September 5	2.6	2.8
May 18	2.6	2.4	September 12	2.4	1.2
May 25		0.4	September 19	2.4	1.4
May 31	2.6	1.6	September 26	2.4	1.3
June 13	2.5	1.4	October 10	2.8	7.0
June 19	2.5	1.4	October 23	2.7	4.2
June 26	2.5	1.4	October 30	2.7	4.0
July 6	2.6	1.9	November 6	2.6	2.9
July 12	2.6	1.9	November 14	2.7	3.1
July 20	2.6	2.0	November 21	2.7	3.3
July 24	2.6	1.8	November 26	2.9	5.2
August 2	2.6	3.1	December 11	2.9	9.6
August 8	2.6	3.3	December 18	2.8	8.7
August 15	2.6	3.6	December 24	2.7	8.3
August 21	2.7	3.1	December 31[a]	3.0	31.

[a] Discharge of Cottonwood Wash.

CHEVELON FORK NEAR WINSLOW, ARIZ.

This station was established December 18, 1905. It is located above the mouth of the river, in sec. 34, T. 18 N., R. 17 E., 19 miles east of Winslow, Ariz. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 157.

A staff gage was set about 25 feet upstream from the automatic water stage register on May 14, 1906. The bench mark is a bolt in a rock between the cable and automatic register; elevation, 28.375 feet above zero of both gages.

On October 1, 1906, a well point and 10 feet of 2-inch pipe was laid from the bottom of the tube out into the stream and securely connected to the bottom of the creek and to the float tube. This obviates the trouble caused by sand collecting in and about the bottom of the float tube.

Discharge measurements of Chevelon Fork near Winslow, Ariz., by Reed and Newman, in 1905–1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1905.	*Feet.*	*Sec.-ft.*	1906.	*Feet.*	*Sec.-ft.*
November 3	......	8.2	June 30	−0.20	0.5
November 25	1.00	.9	July 7	−.20	4
December 19	2.10	33	July 10	−.20	.4
			July 14	−.20	4
1906.			July 21	−.20	.6
February 3	1.80	57	July 28	.00	1.2
February 10	2.60	135	August 4	.60	2
February 17	2.40	107	August 11	1.00	2.9
February 24	2.90	147	August 18	.10	.7
March 3	2.60	132	August 25		.4
March 12	2.80	148	September 1	.30	1
March 18	3.55	546	September 8	...	.3
March 19	3.23	453	September 15		.3
March 24	3.10	212	September 22	..	.3
March 28	4.70	1,250	September 29	.20	7
March 31	3.20	266	October 6	.10	3
April 7	1.80	61	October 13	00	.25
April 14	2.00	66	October 20	−.10	.25
April 21	1.40	21	October 27	−.10	.25
April 28	0.80	4.3	November 3	−.10	.25
May 5	.30	1.2	November 10	−.10	.25
May 12	.20	.7	November 17	−.10	.25
May 19	.20	.7	November 24	−.10	.25
May 26	.10	.6	December 1	−.10	.25
June 3	.00	.5	December 8	3.50	119
June 9	.00	.8	December 15	2.70	37
June 16	.00	.8	December 22	60	18
June 23	−.10	.4	December 29	80	16

Daily gage height, in feet, of Chevelon Fork near Winslow, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.85	1.77	3.16	3.00	0.65	0.05	−0.15	2.72	0.30	0.23	−0.07	0.60
2	1.85	1.77	3.05	2.90	.57	.05	− .15	.86	.25	.15	− .10	1.97
3	1.85	1.80	2.75	2.66	.52	.05	− .15	.60	.18	.10	− .10	2.15
4	1.85	1.80	2.69	2.41	.45	.05	− .15	.60	.13	.10	− .10	8.16
5	1.80	1.80	2.52	2.44	.38	.05	− .15	.60	.10	.10	− .10	5.75
6	1.80	1.88	2.35	2.05	.34	.05	− .15	.55	.08	.10	− .10	5.70
7	1.80	2.28	2.30	1.73	.32	.05	− .15	2.88	.05	.10	− .10	5.65
8	1.80	2.62	2.27	2.15	.31	.05	− .20	4.07	.48	.10	− .10	5.60
9	1.80	2.60	2.28	2.81	.30	.05	− .20	1.88	1.35	.10	− .10	5.40
10	1.80	2.57	2.50	3.58	.30	.05	− .20	1.00	.45	.10	− .10	5.20
11	1.80	2.52	3.33	3.15	.28	.00	− .20	1.00	.25	.05	− .10	4.95
12	1.80	2.50	2.98	2.56	.25	.00	− .20	.90	.18	.05	− .10	4.60
13	1.80	2.52	8.16	2.21	.25	.00	− .20	.70	.10	.05	− .10	4.20
14	1.80	2.45	7.89	2.05	.20	.00	− .15	.50	.10	.00	− .10	3.60
15	1.80	2.31	5.70	2.36	.20	.00	− .20	1.20	.00	.00	− .10	2.95
16	1.80	2.33	4.77	2.15	.20	.00	− .20	.34	.00	.00	− .10	2.50
17	1.80	2.40	4.30	1.76	.20	.00	− .20	.20	.00	− .05	− .10	2.00
18	1.70	2.43	3.65	1.36	.20	− .05	− .20	.20	.00	− .05	− .10	1.44
19	1.75	2.45	3.28	1.30	.20	− .05	− .20	.20	.00	− .10	− .10	.77
20	2.04	2.78	2.95	1.63	.20	− .05	− .20	.20	.00	− .10	− .10	1.08
21	2.62	2.91	2.78	1.56	.20	− .10	− .20	.15	.00	− .10	− .10	.85
22	2.65	2.95	2.88	1.35	.20	− .10	.00	.10	.00	− .10	− .10	.65
23	2.65	3.00	2.79	1.23	.15	− .10	1.75	.10	.00	− .10	− .10	.60
24	2.65	2.90	3.32	1.13	.10	− .10	.60	.05	.00	− .10	− .10	.55
25	2.65	2.64	3.83	1.05	.10	− .15	.23	.00	.00	− .10	− .10	.45
26	2.48	2.52	7.71	1.00	.10	− .15	.32	.00	.00	− .10	− .10	.40
27	1.98	2.65	8.56	.95	.10	− .15	.20	.21	1.37	− .10	− .10	.38
28	1.87	2.90	4.68	.85	.10	− .15	.05	2.58	.60	− .10	− .10	.45
29	1.80	....	4.05	.77	.10	− .15	.00	1.65	.30	− .10	− .10	.30
30	1.77	....	3.55	.73	.10	− .15	− .05	.65	.28	− .10	− .10	.30
31	1.77	....	3.08	....	.05	....	1.06	.40	....	− .10	....	.30

Daily discharge, in feet, of Chevelon Fork near Winslow, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	52	45	251	210	3	0.75	0.5	151	1	0.3	0.25	35
2	52	45	222	187	2	.75	.5	2	1	.25	.25	57
3	52	57	157	142	2	.75	.5	2	1	.25	.25	80
4	52	48	155	110	1	.75	.5	2	0.75	.25	.25	3,600
5	48	48	125	111	1	.75	.5	2	.50	.25	.25	127
6	48	53	101	70	1	.75	.5	2	.5	.25	.25	126
7	48	92	96	44	1	.75	.5	183	1.5	.25	.25	123
8	48	137	93	80	1	.75	.5	832	.25	.25	.25	122
9	48	135	95	169	1	.75	.5	54	18	.25	.25	117
10	48	128	120	498	1	.75	.5	3	.25	.25	.25	110
11	48	125	328	250	1	.5	.5	3	.25	.25	.25	100
12	48	120	207	128	1	.5	.5	2	.25	.25	.25	92
13	48	125	3,600	87	1	.5	.5	2	.25	.25	.25	80
14	48	113	3,430	70	1	.5	.5	2	.25	.25	.25	63
15	48	97	1,930	106	1	.5	.5	14	.25	.25	.25	45
16	48	100	1,298	80	1	.5	.5	1	.25	.25	.25	35
17	48	107	988	45	1	.5	.5	1	.25	.25	.25	29
18	41	111	546	19	1	.5	.5	1	.25	.25	.25	23
19	44	113	303	17	1	.5	.5	1	.25	.25	.25	28
20	69	163	198	37	1	.5	.5	1	.25	.25	.25	20
21	138	190	163	31	1	.5	.5	1	.25	.25	.25	19
22	145	198	183	20	1	.5	.75	.5	.25	.25	.25	18
23	145	210	165	15	.75	.5	40	.5	.25	.25	.25	18
24	145	147	321	12	.75	.5	2	.5	.25	.25	.25	18
25	145	138	668	11	.75	.5	.75	.5	.25	.25	.25	17
26	115	125	3,300	10	.75	0.5	.75	.5	.25	25	.25	17
27	62	140	3,870	8	.75	.5	.75	0.5	119	.25	.25	17
28	53	147	1,237	6	.75	.5	.5	130	2	.25	.25	17
29	48	....	818	4	.75	.5	.5	38	.75	.25	.25	16
30	45	....	478	3	.75	.5	.5	2	.75	.25	.25	16
31	45	....	230	....	.75	....	11	2	....	.25	....	16

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Google

Monthly discharge of Chevelon Fork near Winslow, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	145	41	66.8	4,110
February	210	45	116	6,440
March	3,870	93	828	50,900
April	498	3	86.0	5,120
May	3.00	.75	1.06	65.2
June	.75	.50	.58	34.5
July	45.0	.50	2.36	145
August	832	.50	46.4	2,850
September	119	.25	5.04	300
October	.30	.25	.25	15.4
November	.25	.25	.25	14.9
December	3,600	16	168	10,300
The year	3,870	.25	110	80,300

CLEAR CREEK NEAR WINSLOW, ARIZ.

This station was established June 13, 1906. It is located 6 miles from Winslow and 3 miles above the Clear Creek Irrigation Company's dam and the county bridge. It is one-half mile above the pump house.

The channel is straight for 250 feet above and 500 feet below the station. The current is good at all stages. Both banks are perpendicular cliffs and will not overflow. The bed of the stream is strewn with large bowlders and is permanent. There is one channel at all stages.

Discharge measurements are made by means of a cable, car, and tagged wire. A stay wire is used for high-water measurements. The initial point is the first tag at the eyebolt to which the tag wire is fastened.

The gage, which is read by E. McFarland, is an automatic water-stage register on a shelf 51 feet above the bottom of the creek. There is also a staff gage 42 feet long bolted to the cliff. The elevation of both gage zeros is the same. The bench mark is a bolt in a wooden plug which has been driven into a hole in the solid ledge 5 feet south of the gage rod; elevation, 35.083 feet above the gage zero.

Discharge measurements of Clear Creek near Winslow, Ariz., by Reed, McFarland and Imel, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 13	2.0	3.51	October 6	2.0	3.45
June 14	2.0	3.42	October 13	2.0	3.48
June 16	2.0	3.46	October 20	2.0	3.83
June 23	2.0	3.29	October 27	2.0	3.75
June 30	2.0	3.19	November 2	2.0	3.87
July 7	2.0	3.22	November 10	2.0	3.90
July 14	2.0	3.22	November 17	2.0	3.88
July 21	2.0	3.16	November 24	2.2	5.54
July 28	2.0	3.15	December 4	17.4	4,840
August 11	2.0	3.38	December 5	9.0	2,060
August 18	2.0	3.32	December 6	7.0	1,320
August 25	2.0	3.32	December 8	4.7	521
September 1	2.0	3.36	December 10	4.0	333
September 8	2.0	3.43	December 21	3.1	112
September 15	2.0	3.45	December 22	3.1	114
September 22	2.0	3.61	December 29	2.4	31.9
September 29	2.0	3.46	December 31	4.2	284

Daily gage height, in feet, of Clear Creek near Winslow, Ariz., for 1906.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	1.95	2.70	2.00	2.00	2.00	2.00
2	....	1.95	2.32	2.00	2.00	2.00	2.23
3	2.00	1.95	2.28	2.00	2.00	2.00	2.43
4	2.00	1.95	2.12	2.00	2.00	2.00	8.38
5	2.00	1.95	1.95	2.00	2.00	2.00	9.73
6	2.00	1.95	1.98	2.00	2.00	2.00	7.40
7	2.00	1.95	1.96	2.00	2.00	2.00	5.30
8	2.00	1.95	2.32	2.00	2.00	2.00	4.45
9	2.00	1.95	2.55	2.00	2.00	2.00	3.88
10	2.00	1.95	2.20	2.00	2.00	2.00	3.40
11	2.00	1.95	2.32	2.00	2.00	2.00	3.10
12	2.00	1.95	2.15	2.00	2.00	2.00	3.08
13	2.00	1.95	2.15	2.00	2.00	2.00	2.86
14	2.00	1.95	2.15	2.00	2.00	2.00	4.06
15	2.00	2.00	2.15	2.00	2.00	2.00	5.25
16	2.00	2.05	2.10	2.00	2.00	2.00	4.60
17	1.95	2.00	2.07	2.00	2.00	2.00	4.05
18	1.95	2.00	2.00	2.00	2.00	2.00	3.68
19	1.95	2.00	2.00	2.00	2.00	2.00	3.45
20	1.95	2.00	2.00	2.00	2.00	2.00	3.40
21	1.95	2.00	2.00	2.00	2.00	2.00	3.20
22	1.95	2.00	1.95	2.00	2.00	2.00	3.10
23	1.95	2.00	1.95	2.00	2.00	2.00	2.80
24	1.95	1.95	1.95	2.00	2.00	2.00	2.70
25	1.95	1.95	1.95	2.00	2.00	2.00	2.60
26	1.95	1.95	2.00	2.00	2.00	2.00	2.45
27	1.95	1.95	2.00	2.00	2.00	2.00	2.40
28	1.95	1.95	2.00	2.00	2.00	2.00	2.35
29	1.95	2.00	2.00	2.00	2.00	2.00	2.30
30	1.95	2.00	2.00	2.00	2.00	2.00	2.30
31	....	2.03	2.00	....	2.00	....	3.48

Daily discharge, in second-feet, of Clear Creek near Winslow, Ariz., for 1906.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	3.20	70	3.36	3.45	3.86	5.5
2	....	3.20	22	3.37	3.45	3.87	12
3	3.50	3.20	20	3.38	3.45	3.87	33
4	3.50	3.20	5	3.39	3.45	4.87	1,790
5	3.50	3.20	3	3.40	3.45	3.88	2,245
6	3.50	3.20	3	3.41	3.45	3.88	1,460
7	3.50	3.22	3	3.42	3.46	3.89	720
8	3.50	3.22	22	3.43	3.46	3.89	420
9	3.50	3.22	43	3.43	3.46	3.90	250
10	3.50	3.22	11	3.43	3.47	3.90	155
11	3.50	3.22	22	3.43	3.47	3.90	110
12	3.50	3.22	6	3.44	3.48	3.90	108
13	3.50	3.22	6	3.44	3.48	3.90	80
14	3.42	3.22	6	3.44	3.54	3.90	290
15	3.45	3.21	6	3.45	3.58	3.90	700
16	3.46	3.20	3.33	3.47	3.62	3.88	475
17	3.43	3.19	3.32	3.49	3.60	3.88	290
18	3.40	3.18	3.32	3.59	3.70	4.04	208
19	3.37	3.17	3.32	3.53	3.77	4.20	162
20	3.34	3.16	3.32	3.55	3.83	4.30	155
21	3.32	3.16	3.32	3.59	3.83	4.52	122
22	3.30	3.15	3.32	3.61	3.82	4.68	110
23	3.29	3.15	3.32	3.59	3.80	4.85	70
24	3.27	3.15	3.32	3.51	3.79	5.02	60
25	3.25	3.15	3.32	3.54	3.77	5.19	50
26	3.23	3.15	3.32	3.51	3.76	5.32	35
27	3.21	3.15	3.32	3.49	3.75	5.54	30
28	3.20	3.15	3.33	3.47	3.77	5.00	25
29	3.19	3.16	3.34	3.46	3.79	5.50	20
30	3.20	3.17	3.35	3.46	3.82	5.50	20
31	....	3.18	3.36	....	3.84	....	167

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Clear Creek near Winslow, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June (3-30)	3.50	3.19	3.39	188
July	3.22	3.15	3.19	196
August	70.0	3.00	9.80	603
September	3.61	3.36	3.47	206
October	3.84	3.45	3.62	223
November	5.54	3.86	4.32	257
December	2,245	5.5	335	20,600
The period				22,300

WOODRUFF DITCH NEAR WOODRUFF, ARIZ.

Woodruff ditch diverts water from the north side of Little Colorado River at the point where provision is made for the overflow of the surplus water. The sill of the intake gate is slightly raised above the crest of the spillway.

This water so diverted is used to irrigate lands on the north side of the river in and about the town of Woodruff and takes practically the entire flow during the low-water season.

Measurements are made just below the canal headgate.

Discharge measurements of Woodruff Ditch near Woodruff, Ariz., by Reed and Newman, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
August 10	1.6	16	October 3	.9	3.8
August 13	1.3	10	October 8	1.1	4.5
August 16	1.4	11	October 12	1.1	4.4
September 5	1.3	10	October 24	.8	3.8
September 6	1.3	9.8	October 26	.9	3.4
September 7		6.8	October 29	1.0	3.9
September 10	.9	5.4	October 30	.9	4.3
September 19	.9	4.4	November 2	.9	4.4
September 20	.9	4.6	November 7	.7	2.7
September 27	.9	4.6	November 12	1.0	5.2
September 28	1.7	18.9	November 20	1.0	5.3

MISCELLANEOUS MEASUREMENTS.

The following is a list of miscellaneous measurements in Little Colorado River drainage basin in 1906.

Miscellaneous measurements in Little Colorado River drainage basin, in 1906.

Date.	Stream.	Locality	Width.	Area of section.	Discharge.
			Feet	*Sq. ft.*	*Sec.-ft.*
May 8	West Snowflake ditch	Headgate	6	2.7	5.7
May 8	East Snowflake ditch	do	5	1.8	1.6
May 8	West Taylor ditch				1.6
May 17	Silver Creek	Dipping Vat	9	15	9.5
May 31	do	do	8	14	9.1

VIRGIN RIVER DRAINAGE BASIN.

MUDDY RIVER NEAR MOAPA, NEV.

Muddy River is a branch of the Virgin, one of the more important tributaries of the Colorado. The stream drains a long narrow strip of country in the eastern part of Lincoln County, Nev., flows southward, and joins the Virgin about 25 miles above the point where the latter stream enters the Colorado.

The gaging station was established January 1, 1904. It is located near the crossing of the San Pedro, Los Angeles and Salt Lake Railroad, about 6 miles downstream from Moapa, Nev. The station is above the Narrows and will show the amount of water available for storage at the proposed reservoir site in the Narrows. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 157, where are given also references to publications that contain data for previous years.

Discharge measurements of Muddy River near Moapa, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 24	H. H. Church	9	42	2.7	48
February 28	do	9	36	2.5	45
March 21	do	8	31	2.7	50
April 24	do	6	22	2.2	34
May 26	do	8	27	2.3	40
June 28	do	11	34	2.6	41
July 26	do	9	25	2.3	35
November 22	do	9	41	2.4	45

Daily gage height, in feet, of Muddy River near Moapa, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	2.6	2.5	2.5	2.3	2.3	2.5	2.2	......	2.6	2.55	2.9
2	2.7	2.6	2.55	2.6	2.4	2.4	2.5	2.2	......	2.6	2.6	2.9
3	2.7	2.6	2.6	2.6	2.4	2.4	2.6	2.2	......	2.6	2.6	2.95
4	2.8	2.6	2.6	2.55	2.3	2.3	2.6	2.2	......	2.6	2.65	3.0
5	2.8	2.55	2.6	2.55	2.2	2.3	2.7	2.2	......	2.6	2.7	3.4
6	2.8	2.5	2.6	2.7	2.2	2.4	2.7	2.2	2.8	2.6	2.7	3.8
7	2.7	2.5	2.6	4.2	2.2	2.5	2.7	2.2	2.8	2.6	2.7	3.3
8	2.6	2.5	2.5	7.75	2.1	2.5	2.6	2.3	2.85	2.6	2.7	3.15
9	2.7	2.4	2.5	6.0	2.1	2.4	2.5	2.3	2.8	2.6	2.7	3.1
10	2.7	2.55	2.5	3.5	2.1	2.3	2.5	2.3	2.8	2.6	2.7	3.0
11	2.6	2.85	2.5	4.2	2.15	2.35	2.6	2.3	2.8	2.6	2.7	3.05
12	2.7	2.65	3.45	3.95	2.35	2.4	2.6	2.3	2.8	2.6	2.7	3.2
13	2.7	2.6	5.45	3.4	2.2	2.4	2.6	2.3	2.9	2.6	2.7	3.2
14	2.6	2.85	6.5	2.8	2.2	2.5	5.5	2.2	2.9	2.6	2.7	3.6
15	2.6	2.7	9.0	2.6	2.3	2.5	2.7	2.2	2.8	2.6	2.6	3.2
16	2.6	2.65	3.2	2.55	2.3	2.5	2.5	2.2	2.7	2.6	2.6	3.0
17	2.6	2.6	2.85	2.4	2.3	2.55	3.75	2.2	2.7	2.6	2.6	3.0
18	2.9	2.6	2.6	2.35	2.4	2.6	2.85	2.25	2.7	2.6	2.7	3.0
19	2.95	2.6	2.5	2.3	2.4	2.65	2.5	5.6	2.7	2.5	2.7	3.0
20	3.55	2.5	2.55	2.2	2.4	2.7	2.45	7.5	2.8	2.5	2.7	3.2
21	2.95	2.5	2.55	2.2	2.3	2.8	2.4	16.0	2.8	2.5	2.6	3.2
22	2.8	2.6	2.5	2.2	2.3	2.8	2.3	11.5	2.8	2.5	2.6	3.2
23	2.8	2.6	2.45	2.1	2.3	2.75	2.3	5.5	2.7	2.6	3.25	3.2
24	2.7	2.6	2.45	2.1	2.3	2.7	2.2	4.0	2.7	2.6	2.9	3.2
25	2.6	2.5	7.25	2.15	2.3	2.7	2.2	3.5	2.7	2.6	2.7	3.2
26	2.6	2.5	21.5	2.2	2.3	2.7	2.3	3.5	2.7	2.6	2.7	3.2
27	2.6	2.5	5.0	2.2	2.3	2.6	2.5	3.5	2.6	2.6	2.8	3.4
28	2.6	2.5	2.75	2.3	2.3	2.6	2.5	......	2.6	2.5	2.85	3.4
29	2.7	......	2.7	2.3	2.3	2.6	3.5	......	2.6	2.5	3.0	3.4
30	2.6	......	2.6	2.3	2.3	2.5	2.3	......	2.6	2.5	2.9	3.45
31	2.6	......	2.5	......	2.3	......	2.3	......	......	2.5	......	3.5

GILA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Gila River rises in western and southwestern New Mexico, receiving its waters from mountains having an elevation of from 7,000 to 8,000 feet. At the point where it crosses into Arizona it still has an elevation of 6,000 feet. From this place it flows between mountain ranges, falling rapidly, until at Florence, 180 miles away, it is about 1,500 feet above sea level. At a point about 15 miles above Florence the river emerges upon the plains, through which it winds for about 75 miles before receiving the waters of its principal tributary, the Salt. From the junction of the Salt the Gila continues west and southwest and enters the Colorado at Yuma, Ariz., near the southwestern corner of the Territory.

The principal tributaries are the San Pedro and Santa Cruz rivers from the south, and the San Francisco, Salt, Aqua Fria, and Hassayampa rivers from the north.

San Francisco River rises in the southwestern part of Socorro County, N. Mex., and flows southwestward into Graham County, Ariz., where it unites with the Gila. The basin comprises approximately 1,800 square miles of high, mountainous country.

Salt River, though considered a tributary of the Gila, is in fact larger both in catchment area and in discharge. It receives the drainage from central Arizona, its principal tributary, the Verde, flowing southeasterly and south from the mountains and table-lands south of Colorado River. The Verde Valley is situated in Yavapai County, Ariz., on the headwaters of the stream, and extends from a canyon above Camp Verde to a point about 10 miles below the fort. About a mile above the junction of the Verde and 30 miles above Phoenix the Salt enters upon the plains of the Gila Valley.

San Pedro River rises in the northern part of the Mexican State of Sonora, flows northward for more than 100 miles, and empties into the Gila a few miles below the town of Dudleyville, 45 miles above Florence, Ariz. Rising in a country of very light snowfall, the river depends for the greater part of its water supply on the frequent showers of the rainy seasons. It flows over a sandy bed between high, steep banks, and during the dry season it shrinks to an insignificant stream of clear water which rises and sinks in the sand with the varying depth of bed rock.

The floods of the upper Gila and its tributaries are usually short and violent, occurring during the months of January and February. The season of low water occurs in June and July.

GILA RIVER NEAR CLIFF, N. MEX.

This station was established September 9, 1904. It is located 9 miles below Cliff post-office, one-half mile below the mouth of Mancos River and 40 miles from Silver City, N. Mex. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 159, where are given also references to publications that contain data for previous years.

Discharge measurements of Gila River near Cliff, N. Mex., by Frank Asplind, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
April 18	5.15	546	July 29	3.20	41
April 19	5.10	522	August 21 [a]	8.40	4,040
May 1	4.80	378	August 22	5.00	249
May 2	4.72	341	August 23	4.86	209
May 3	4.65	319	August 24	4.70	191
May 4	4.60	297	August 25	4.60	176
May 26	4.10	186	August 26	4.50	158
May 27	4.10	185	August 27	4.50	164
May 28	4.05	175	August 28	4.85	226
May 29	3.95	142	August 29	4.85	222
May 30	3.88	126	August 30	4.85	220
May 31	3.80	115	October 18	3.90	70
June 19	3.45	76	October 19	3.90	72
June 20	3.40	67	October 20	3.90	72
June 21	3.35	61	October 21	3.90	73
June 22	3.35	61	October 22	3.95	81
June 23	3.35	61	October 23	3.95	82
June 24	3.35	60	October 24	3.95	82
June 25	3.30	52	October 25	3.98	84
June 26	3.28	48	October 26	3.98	85
June 27	3.25	44	October 27	4.00	93
June 28	3.22	42	October 28	3.95	83
June 29	3.20	40	November 22	4.05	101
July 20	3.65	110	November 23	4.08	105
July 21	3.55	97	November 24	4.10	113
July 22	3.50	91	November 25	4.10	112
July 23	3.48	87	November 26	4.10	114
July 24	3.40	70	November 27	4.10	115
July 25	3.32	58	November 28	4.05	102
July 26	3.30	52	November 29	4.10	115
July 27	3.25	46	November 30	4.10	113
July 28	3.20	42	December 1	4.10	117

Daily gage height, in feet, of Gila River near Cliff, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.20	4.20	5.20	5.50	4.80	3.70	3.20	3.68	4.68	4.05	4.05	4.10
2	4.18	4.20	5.28	5.52	4.72	3.70	3.20	3.60	4.58	4.00	4.10	4.30
3	4.20	4.20	5.12	5.45	4.65	3.70	3.22	3.55	4.48	4.00	4.00	7.20
4	4.12	4.15	4.92	5.50	4.60	3.65	3.70	4.88	4.32	3.98	4.05	4.38
5	4.12	4.18	4.88	5.42	4.55	3.62	3.88	9.00	4.28	3.95	4.10	8.50
6	4.18	4.25	4.85	5.40	4.52	3.60	3.82	4.92	4.18	3.95	4.10	6.65
7	4.15	4.38	4.80	5.50	4.50	3.55	3.82	3.60	4.08	3.95	4.00	5.80
8	4.20	4.60	4.75	5.70	4.45	3.52	3.78	5.15	4.00	3.95	4.00	5.32
9	4.20	4.78	4.75	5.80	4.40	3.50	3.75	5.35	3.98	3.95	4.00	4.92
10	4.20	4.80	4.75	5.65	4.40	3.50	3.78	5.52	3.95	3.92	4.00	4.72
11	4.18	5.28	4.78	5.52	4.40	3.45	3.78	4.72	3.95	3.95	4.00	4.52
12	4.18	6.20	4.92	5.45	4.50	3.45	3.70	4.32	3.90	3.92	4.00	4.35
13	4.20	6.20	8.05	5.40	4.55	3.42	3.70	4.18	3.82	3.90	4.00	4.28
14	4.28	5.92	8.80	5.32	4.50	3.40	3.70	4.35	3.80	3.90	4.00	4.20
15	4.30	5.68	7.65	5.25	4.45	3.40	3.65	4.42	3.80	3.90	4.00	4.07
16	4.40	5.60	6.90	5.20	4.40	3.40	3.70	4.30	3.80	3.90	4.00	4.00
17	4.50	5.52	6.60	5.12	4.32	3.35	3.68	4.30	3.80	3.90	4.00	3.92
18	4.50	5.50	6.35	5.10	4.28	3.35	3.65	4.22	3.80	3.90	4.08	3.82
19	4.50	5.52	6.12	5.10	4.25	3.35	3.68	4.20	3.75	3.90	4.18	3.78
20	4.68	5.60	5.85	5.10	4.25	3.40	3.65	4.32	3.75	3.90	4.15	3.70

Daily gage height, in feet, of Gila River near Cliff, N. Mex., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	4.92	5.78	5.60	5.10	4.25	3.40	3.55	6.62	3.75	3.90	4.20	3.65
22	4.72	5.65	5.60	5.00	4.25	3.38	3.48	4.88	3.80	3.92	4.10	3.60
23	4.50	5.68	5.60	5.00	4.22	3.35	3.45	4.78	3.90	3.95	4.10	3.60
24	4.42	5.45	5.65	5.00	4.12	3.35	3.35	4.68	3.92	3.95	4.10	3.58
25	4.38	5.30	5.70	4.95	4.10	3.32	3.30	4.60	4.05	3.95	4.10	3.50
26	4.30	5.18	6.00	4.95	4.10	3.30	3.33	4.50	4.02	4.00	4.10	3.50
27	4.30	5.10	6.50	4.95	4.10	3.28	3.28	4.50	3.98	3.98	4.10	3.50
28	4.28	5.10	6.22	4.90	4.05	3.22	3.23	4.68	3.95	3.95	4.05	3.65
29	4.22	......	6.12	4.85	3.90	3.20	3.20	4.82	3.95	3.98	4.10	6.50
30	4.20	......	5.82	4.82	3.82	3.20	3.45	4.82	3.95	4.12	4.08	6.10
31	4.20	......	5.52	......	3.78	......	3.60	4.72	......	4.10	......	5.76

Daily discharge, in second-feet, of Gila River near Cliff, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	204	204	566	704	382	112	32	109	189	97	97	104
2	200	204	603	713	343	112	32	96	174	90	104	132
3	204	204	529	681	318	112	35	88	163	90	90	2,394
4	186	193	437	704	300	102	112	405	121	87	97	247
5	186	200	419	667	288	99	141	5,250	129	83	104	4,175
6	200	216	405	658	283	96	131	437	115	83	104	1,640
7	193	247	382	704	276	88	131	96	101	83	90	575
8	204	300	359	800	258	83	125	543	90	83	90	338
9	204	373	359	860	252	80	120	635	87	83	90	230
10	204	382	359	773	252	80	125	713	83	79	90	195
11	200	603	373	713	252	72	125	345	83	83	90	165
12	200	1,140	437	681	276	72	112	233	76	79	90	139
13	204	1,140	3,380	658	288	67	112	199	65	76	90	129
14	222	944	4,850	621	276	64	112	240	62	76	90	118
15	228	790	2,725	589	258	64	104	257	62	76	90	100
16	252	750	1.820	566	252	64	112	228	62	76	90	90
17	276	713	1,460	529	232	56	109	228	62	76	90	79
18	276	704	1,250	520	224	56	104	209	62	76	101	65
19	276	713	1,084	520	216	56	109	204	60	76	115	60
20	329	750	895	520	216	64	104	233	60	76	109	55
21	437	848	750	520	216	64	88	1,600	60	76	118	48
22	345	775	750	474	216	63	77	223	62	79	104	45
23	276	790	750	474	209	56	72	206	76	83	104	45
24	256	681	775	474	187	56	56	189	79	83	104	42
25	247	612	800	451	182	51	48	178	97	83	104	36
26	228	557	1,000	451	182	48	53	163	93	90	104	36
27	228	520	1,370	431	182	45	45	163	87	87	104	36
28	222	520	1,154	428	171	35	37	189	83	76	97	48
29	208	......	1,105	405	144	32	32	211	83	87	104	1,435
30	204	......	874	391	134	32	72	211	83	107	101	887
31	204	......	713	......	125	......	96	196	....	104	...	549

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Gila River near Cliff, N. Mex., for 1906.

Month.	Discharge in second-feet.			otal in acre-feet.
	Maximum.	Minimum.	Mean.	
January	437	186	236	14,500
February	1,140	193	574	31,900
March	4,850	359	1,060	65,200
April	860	391	590	35,100
May	382	125	238	14,600
June	112	32.0	69.4	4,130
July	141	32.0	89.1	5,480
August	5,250	88.0	461	28,300
September	189	60.0	90.3	5,370
October	107	76.0	83.3	5,120
November	118	90.0	98.5	5,860
December	4,180	36.0	459	28,200
The year	5,250	32.0	337	244,000

GILA RIVER AT DOME (GILA CITY), ARIZ.

This station was established October 15, 1903. It is located 20 miles above the junction of the Gila with the Colorado. The point of gaging first established was one-fourth mile north of the depot at Dome. The river now flows in a channel fully 1 mile north of the original channel.

The Gila carries an enormous amount of mud and sand. At times the waves of sand traveling along the bed of the stream are so large, the current is so swift, and the stream so shallow, that the water is broken into a uniform succession of waves 2 feet high and over. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 164, where are given also references to publications that contain data for previous years.

Discharge measurements of Gila River at Dome, Ariz., in 1906.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
January 6	W. D. Smith	6.80	1,550
January 24	do	7.95	4,950
Febuary 16	do	9.40	[a]7,500
February 18	do	7.65	4,500
March 15	do	12.50	[a]55,000
March 29	do	12.00	[a]45,000
May 6	do	7.55	1,500
June 12	do	5.00	27
August 23	do	5.30	64

[a] Estimated from gage heights at Yuma, Laguna, and Dome, and from measured discharge at Yuma.

Daily gage height, in feet, of Gila River at Dome, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.2	7.3		9.0	8.0							
2	7.0		7.5			5.5			5.5			
3	7.0	7.0		8.8	7.9							
4	6.9		7.4			5.4			5.3			
5		7.0		8.6	7.8							10.1
6	6.8		7.6			5.3			5.2			
7		6.9		8.4	7.6							11.0
8	6.9		7.4			5.2			5.15			
9		6.8		8.8	7.4							9.5
10	6.8		7.1	10.0		5.1			5.1			
11		6.8		9.4	7.2							8.0
12	6.7		6.8			5.0			5.0			
13		6.9		8.9	7.1							7.1
14	6.6		6.7			4.9			4.8			
15		7.6	12.5	8.8	7.0							6.0
16	6.6	9.45	10.5			4.8						
17		7.9	9.5	8.5	6.8							6.9
18	6.6	7.6	8.5			4.7		6.0				
19			8.5	8.1	6.55			5.5				6.75
20	6.6	7.6	8.0			4.7		7.0				
21				8.3	6.25			6.0				6.55
22	6.6	7.5	8.0			4.7		5.6				
23	8.55			8.25	6.0			5.3				6.4
24	8.0	7.9	7.8			4.7		5.0				
25	7.7		7.6	8.2	5.9			5.0				6.25
26	7.5	7.7				4.7						
27			9.4	8.15	5.8			7.0				6.1
28	7.4	7.7	11.9			4.7						
29			12.0	8.1	5.7			6.6				6.0
30	7.5		9.25			4.7						
31			9.0		5.6			6.0				10.0

NOTE.—River dry June 17 to August 17 and September 15 to December 4.

Daily discharge, in second-feet, of Gila River at Dome, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,400	2,600	3,250	9,200	4,400	380	0	0	550	0	0	0
2	2,000	2,300	3,000	8,600	4,240	340	0	0	340	0	0	0
3	2,000	2,000	2,900	8,000	4,090	300	0	0	260	0	0	0
4	1,850	2,000	2,800	7,440	3,940	260	0	0	190	0	0	0
5	1,780	2,000	3,020	6,890	3,790	220	0	0	160	0	0	17,900
6	1,720	1,920	3,240	6,420	3,520	190	0	0	120	0	0	23,400
7	1,780	1,850	3,020	5,940	3,240	160	0	0	110	0	0	29,000
8	1,850	1,780	2,800	6,970	3,000	120	0	0	100	0	0	20,800
9	1,780	1,720	2,500	8,000	2,800	90	0	0	100	0	0	12,600
10	1,720	1,720	2,190	16,800	2,600	80	0	0	100	0	0	8,500
11	1,660	1,720	1,860	11,800	2,400	60	0	0	70	0	0	4,400
12	1,600	1,780	1,720	10,200	2,300	40	0	0	40	0	0	3,300
13	1,540	1,850	1,660	8,500	2,190	30	0	0	20	0	0	2,190
14	1,470	2,540	1,600	8,250	2,100	20	0	0	10	0	0	1,480
15	1,470	3,240	54,600	8,000	2,000	20	0	0	0	0	0	760
16	1,470	11,800	22,500	7,200	1,840	10	0	0	0	0	0	1,300
17	1,470	4,090	12,600	6,400	1,720	0	0	0	0	0	0	1,850
18	1,470	3,240	6,400	6,170	1,560	0	0	760	0	0	0	1,760
19	1,470	3,240	6,400	5,940	1,410	0	0	340	0	0	0	1,660
20	1,470	3,240	4,400	5,720	1,230	0	0	2,000	0	0	0	1,540
21	1,470	3,120	4,400	5,510	1,050	0	0	760	0	0	0	1,410
22	1,470	3,000	4,400	5,400	900	0	0	420	0	0	0	1,320
23	6,640	3,540	4,100	5,300	760	0	0	190	0	0	0	1,230
24	4,400	4,090	3,790	5,200	710	0	0	40	0	0	0	1,140
25	3,500	3,800	3,240	5,100	670	0	0	40	0	0	0	1,050
26	3,000	3,500	7,520	5,000	630	0	0	1,020	0	0	0	960
27	2,900	3,500	11,800	4,910	590	0	0	2,000	0	0	0	870
28	2,800	3,500	43,500	4,820	540	0	0	1,740	0	0	0	810
29	2,900	....	45,200	4,730	500	0	0	1,470	0	0	0	760
30	3,000	....	10,800	4,560	460	0	0	1,120	0	0	0	8,780
31	2,800	....	9,200	....	420	....	0	760	....	0	....	16,800

NOTE.—The above daily discharges have been obtained from an approximate rating table.

Monthly discharge of Gila River at Dome, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	6,640	1,470	2,220	136,000
February	11,800	1,720	3,020	168,000
March	54,600	1,600	9,370	576,000
April	16,800	4,560	7,100	422,000
May	4,400	420	1,990	122,000
June	380	0	77	4,580
July	0	0	0	0
August	2,000	0	408	25,100
September	550	0	72	4,280
October	0	0	0	0
November	0	0	0	0
December	29,000	0	5,400	332,000
The year	54,600	0	2,470	1,790,000

SAN FRANCISCO RIVER AT ALMA, N. MEX.

This station was established October 18, 1904. It is located about one-half mile south of Alma, N. Mex., and 85 miles northwest of Silver City. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 166, where are given also references to publications that contain data for previous years.

Discharge measurements of San Francisco River at Alma, N. Mex., by F. Asplind, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet*	*Sec.-ft.*
January 1	1.40	19	June 7	1.00	8
January 3	1.48	30	June 8	.98	8
January 4	1.40	21	June 9	.98	7
January 5	1.45	28	June 11	.90	3
January 8	1.45	28	June 13	.90	3
January 16	1.52	39	June 14	.90	4
January 17	1.55	41	June 16	.88	2
January 18	1.58	48	July 2	0.88	1
January 19	1.60	50	July 3	.88	1
January 20	2.32	214	July 6	1.35	34
January 22	1.65	63	July 7	1.30	31
January 23	1.60	49	July 9	1.10	13
January 25	1.65	59	July 10	.92	4
January 26	1.65	60	July 12	.90	4
January 27	1.60	49	July 13	1.08	10
January 29	1.62	55	July 14	.98	6
January 30	1.60	52	July 16	1.42	48
February 2	1.62	55	July 17	1.75	127
February 3	1.60	54	July 18	1.50	66
February 5	1.65	64	August 1	1.20	11
February 6	1.78	101	August 3	1.15	9.0
February 7	1.90	141	August 4	1.10	5.6
February 8	2.02	180	August 6	1.20	13
February 9	2.15	236	August 7	2.20	208
February 10	2.10	208	August 8	1.20	13
February 13	2.40	315	August 10	2.90	576
February 14	2.10	212	August 11	1.40	38
February 16	2.10	210	August 13	1.25	21
February 21	2.30	275	August 14	1.80	124
February 22	2.55	390	August 15	1.35	34
February 23	2.50	373	August 16	1.55	62
February 24	2.30	275	August 17	1.30	26
February 26	2.18	240	August 18	1.25	21
February 27	2.25	252	September 4	1.20	15
March 1	2.50	363	September 5	1.20	15
March 3	2.15	219	September 7	1.10	10
March 5	2.10	209	September 8	1.08	8.9
March 7	2.10	203	September 10	1.05	7.5
March 8	2.15	224	September 11	1.00	5.7
March 9	2.25	268	September 12	1.00	6.7
March 10	2.30	285	September 13	1.00	7.4
March 12	2.45	321	September 14	2.68	397
March 13	4.30	1,250	September 15	1.50	54
March 14[a]	5.20	2,080	September 17	1.30	25
March 15	4.00	1,080	September 18	1.25	18
March 16	3.40	830	September 19	1.15	9.5
March 17	3.05	599	September 20	1.20	13
March 20	2.70	428	September 21	1.10	5.2
March 21	2.65	393	September 22	1.10	5.1
March 23	2.70	421	September 24	1.15	7.5
March 27	3.45	867	September 25	1.25	16
March 28	3.20	701	September 26	1.30	23
March 29	2.95	582	September 27	1.25	19
March 30	2.80	500	September 28	1.25	17
April 2	2.50	357	October 1	1.20	16
April 3	2.40	302	October 2	1.20	16
April 4	2.35	283	October 3	1.15	8.3
April 5	2.30	260	October 5	1.15	11
April 6	2.50	348	October 6	1.10	6.0
April 7	2.75	441	October 8	1.12	9.4
April 9	2.35	282	October 9	1.10	6.4
April 11	2.30	259	October 10	1.10	6.7
April 24	1.95	182	October 12	1.15	12
April 26	1.90	164	October 13	1.15	11
April 28	1.85	149	October 15	1.15	10
May 7	1.60	84	November 1	1.20	15
May 9	1.55	70	November 2	1.35	30
May 11	1.48	53	November 3	1.25	18
May 12	1.45	50	November 5	1.22	16
May 14	1.45	49	November 7	1.22	16
May 15	1.40	37	November 8	1.20	15
May 16	1.35	30	November 9	1.20	15
May 18	1.30	24	November 10	1.20	14
May 19	1.30	25	November 12	1.18	10
May 21	1.30	24	November 13	1.20	14
May 23	1.20	17	November 14	1.20	14
June 2	1.10	14	November 15	1.20	14
June 4	1.10	13	November 17	1.20	13
June 6	1.00	8	November 19	1.20	14
			December 3	6.30	3,050

[a] Float measurement.

Discharge measurements of San Francisco River at Alma, N. Mex., by F. Asplind, in 1906—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
December 3[a]	13.40	21,000	December 22	1.10	48
December 13	1.70	176	December 24	1.05	36
December 14	1.65	150	December 26	1.05	36
December 15	1.45	111	December 27	1.05	36
December 17	1.30	81	December 28	3.08	734
December 18	1.25	70	December 29[a]	4.15	1,414
December 21	1.15	56			

[a] Float measurement.

Daily gage height, in feet, of San Francisco River at Alma, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
1	1.42	1.60	2.40	2.60	1.70	1.05	0.90	1.90	1.35	1.30	1.30	1.45
2	1.42	1.60	2.40	2.52	1.70	1.05	.90	1.55	1.32	1.25	1.30	3.65
3	1.42	1.60	2.30	2.50	1.70	1.00	.95	1.35	1.30	1.20	1.25	5.75
4	1.42	1.60	2.30	2.48	1.60	1.00	1.30	1.35	1.22	1.18	1.25	8.00
5	1.42	1.65	2.20	2.40	1.60	1.00	1.30	1.30	1.18	1.10	1.20	5.15
6	1.42	1.68	2.20	2.42	1.55	1.00	1.30	1.42	1.12	1.10	1.20	4.30
7	1.48	1.90	2.05	2.52	1.50	1.00	1.20	1.85	1.10	1.10	1.20	3.85
8	1.48	2.02	2.00	2.45	1.50	1.00	1.18	1.30	1.08	1.20	1.20	3.55
9	1.48	2.08	2.01	2.45	1.50	1.00	1.13	1.30	1.00	1.20	1.20	2.70
10	1.50	2.10	2.25	2.40	1.45	0.90	1.10	2.08	1.00	1.15	1.20	2.20
11	1.50	2.52	2.25	2.38	1.42	0.90	1.10	1.60	1.00	1.15	1.20	1.95
12	1.50	2.65	2.45	2.30	1.40	0.90	1.00	1.30	1.00	1.15	1.20	1.80
13	1.52	2.42	4.65	2.22	1.4	0.90	.95	1.3	1.15	1.10	1.20	1.68
14	1.52	2.22	5.15	2.20	1.40	0.85	0.92	1.45	2.35	1.10	1.20	1.45
15	1.52	2.10	3.78	2.12	1.40	0.85	0.90	1.52	2.00	1.10	1.20	1.40
16	1.52	2.10	3.30	2.10	1.35	0.85	1.22	1.55	2.00	1.10	1.20	1.35
17	1.55	2.00	3.00	2.00	1.35	0.85	1.68	1.40	1.90	1.10	1.20	1.30
18	1.58	2.05	2.82	2.00	1.35	0.85	1.48	1.30	1.88	1.10	1.20	1.25
19	1.60	2.15	2.72	2.00	1.30	0.85	1.40	1.28	1.70	1.10	1.20	1.20
20	2.15	2.35	2.68	2.00	1.25	0.85	1.50	1.28	1.60	1.10	1.30	1.20
21	1.68	2.40	2.60	1.95	1.25	0.85	1.25	1.40	1.48	1.15	1.38	1.20
22	1.68	2.48	2.70	1.95	1.20	0.85	1.10	1.60	1.28	1.15	1.40	1.15
23	1.60	2.52	2.70	1.92	1.30	0.85	1.05	1.75	1.12	1.20	1.40	1.10
24	1.60	2.35	2.70	1.90	1.30	0.85	1.05	1.38	1.35	1.20	1.40	1.10
25	1.60	2.20	2.65	1.90	1.30	0.85	1.02	1.40	2.00	1.20	1.40	1.05
26	1.60	2.25	2.75	1.90	1.30	0.85	1.40	1.35	1.50	1.20	1.40	1.05
27	1.60	2.35	3.80	1.85	1.20	0.85	1.50	1.90	1.35	1.20	1.40	1.65
28	1.60	2.40	3.15	1.80	1.18	0.85	1.70	1.85	1.25	1.20	1.40	1.88
29	1.60	....	2.95	1.78	1.10	0.85	1.45	1.90	1.45	1.20	1.40	3.75
30	1.60	....	2.75	1.70	1.10	0.85	1.35	1.50	1.30	1.20	1.40	2.65
31	1.60	....	2.60	....	1.05	....	1.33	1.40	....	1.20	....	1.98

Daily discharge, in second-feet, of San Francisco River at Alma, N. Mex., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	23	52	325	405	113	11	2	150	29	23	23	111
2	23	52	325	370	113	11	2	65	25	19	23	1,097
3	23	52	280	350	113	8	5	29	23	15	19	2,627
4	23	52	280	300	84	8	31	29	14	13	19	4,345
5	23	64	240	300	84	8	31	23	11	7	15	2,169
6	23	70	240	310	70	8	31	39	12	7	15	1,520
7	33	137	186	330	55	8	22	130	10	7	15	1,227
8	33	177	170	318	55	8	21	23	9	15	15	1,032
9	33	196	173	325	55	8	16	23	4	15	15	530
10	36	203	260	305	46	8	14	181	5	11	15	320
11	36	379	250	295	41	3	14	75	6	11	15	232
12	36	438	325	265	37	3	8	23	7	11	15	195
13	39	334	1,578	235	37	3	5	23	21	7	15	165
14	39	248	2,040	235	37	3	4	45	232	7	15	110
15	39	203	980	210	37	1	3	59	163	7	15	101

Daily discharge, in second-feet, of San Francisco River at Alma, N. Mex., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	39	203	770	210	31	1	24	65	163	7	15	90
17	44	170	575	180	31	1	110	35	141	7	15	81
18	49	186	485	175	31	1	62	23	137	7	15	72
19	52	222	435	185	25	1	45	21	97	7	15	63
20	222	302	425	190	21	1	66	21	75	7	23	63
21	70	325	370	175	21	1	26	35	51	11	29	63
22	70	348	420	180	17	1	14	75	21	11	36	54
23	52	379	421	170	25	1	11	108	6	15	36	46
24	52	302	445	165	25	1	11	33	29	15	36	46
25	52	240	440	165	25	1	9	35	163	15	36	38
26	52	260	515	164	25	1	45	29	55	15	36	38
27	52	302	1,038	150	17	1	66	141	29	15	36	38
28	52	325	675	135	14	1	116	130	17	15	36	215
29	52	....	585	130	11	1	55	141	45	15	36	1,162
30	52	....	475	105	11	1	38	55	23	15	36	505
31	52	....	405	....	8	....	35	35	....	15	....	244

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of San Francisco River at Alma, N. Mex., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1907.				
January	222	23	47.6	2,930
February	438	52	222	12,300
March	2,040	170	520	32,000
April	405	105	234	13,900
May	113	8	42.4	2,610
June	11	1	3.8	226
July	116	2	30.4	1,870
August	181	21	61.3	3,770
September	232	4	54.1	3,220
October	23	7	11.8	726
November	36	15	22.8	1,360
December	4,340	38	600	36,900
The year	4,340	1	154	112,000

SAN PEDRO RIVER AT CHARLESTON, ARIZ.

This station was established January 22, 1904, and was discontinued September 6, 1906. It is located on the El Paso and Southwestern Railroad about one-half mile west of Charleston station and 6 miles south of Fairbank, Ariz. The conditions and the bench marks are described in Water-Supply Paper No. 175, page 170, where are given also references to publications that contain data for previous years.

On February 23, 1906, the cable was moved 70 feet upstream, where channel conditions are the same. The initial point is the first tag on a wire at the face of the cable support on the right bank. A wash comes in just below the station, but carries water only in time of heavy rain and then only for a few hours. The amount carried can be easily measured.

Discharge measurements of San Pedro River at Charleston, Ariz., by Rayling, Reed, and McGee, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 3	25.4	58	April 24	25.0	26
January 10	25.3	65	April 30	25.0	25
January 17	25.4	59	May 16	25.0	18
January 24	25.4	49	May 24	24.9	16
January 31	25.4	50	May 31	24.9	14
February 17	25.95	164	June 5	24.9	10
February 20	25.5	83	June 13	24.9	9.2
February 24	25.6	65	June 28	24.8	4.1
March	25.4	44	August 11	25.5	50
April 8	25.3	33	August 18	26.5	13
April 16	25.2	29	August 28	25.2	50

Daily gage height, in feet, of San Pedro River at Charleston, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	25.4	25.35	25.4	25.3	25.0	24.9	25.2	25.5
2	25.4	25.35	25.4	25.3	25.0	24.9	25.2	25.5
3	25.4	25.3	25.4	25.3	25.0	24.9	25.2	25.5
4	25.4	25.15	25.4	25.3	25.0	24.9	25.2	25.5
5	25.4	25.15	25.4	25.3	25.0	24.9	25.2	27.7
6	25.4	25.2	25.3	25.3	25.0	24.9	25.2	26.7
7	25.4	25.45	25.3	25.3	25.0	24.9	25.2	26.5
8	25.4	25.55	25.3	25.3	25.0	24.9	25.4	26.9
9	25.4	25.75	25.4	25.3	25.0	24.9	25.4	26.6
10	25.4	25.85	25.3	25.3	25.0	24.9	25.4	25.5
11	25.4	26.15	25.3	25.3	25.0	24.9	25.4	25.5
12	25.4	25.95	25.3	25.2	25.0	24.9	25.4	26.5
13	25.4	28.5	25.5	25.2	25.0	24.9	25.4	25.75
14	25.4	27.3	26.7	25.2	25.0	24.9	25.4	25.45
15	25.4	27.1	25.6	25.2	25.0	24.9	25.4	25.3
16	25.4	26.0	25.5	25.2	25.0	24.9	25.4	29.9
17	25.4	25.8	25.5	25.2	25.0	24.9	25.2	26.7
18	25.4	25.1	25.5	25.0	25.0	24.9	25.2	26.5
19	25.4	25.6	25.5	25.0	24.9	24.9	25.2	25.2
20	25.4	25.5	25.5	25.0	24.9	24.9	25.2	26.5
21	25.4	25.5	25.4	25.0	24.9	24.9	25.6	27.3
22	25.4	25.5	25.4	25.0	24.9	24.9	25.6	26.5
23	25.4	25.5	25.4	25.0	24.9	24.9	25.6	25.4
24	25.4	25.5	25.4	25.0	24.9	24.9	25.4	25.2
25	25.4	25.5	25.4	25.0	24.9	24.9	25.4	25.2
26	25.4	25.5	25.3	25.0	24.9	24.9	25.8	25.2
27	25.4	25.5	25.3	25.0	24.9	24.9	25.8	25.2
28	25.4	25.5	25.3	25.0	24.9	24.9	25.6	25.2
29	25.4	....	25.3	25.0	24.9	24.9	25.6	25.2
30	25.4	....	25.3	25.0	24.9	24.9	25.6	25.5
31	25.4	....	25.3	....	24.9	....	25.6	26.6

Daily discharge, in second-feet, of San Pedro River at Charleston, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	58	40	60	33	25	4	20	40
2	58	40	60	33	24	6	20	40
3	58	28	60	33	24	7	21	40
4	59	20	60	33	23	9	22	40
5	60	20	60	33	23	10	23	519
6	61	24	36	33	22	10	23	316
7	62	60	36	33	21	10	24	174
8	63	80	36	33	21	10	25	358
9	64	123	45	33	20	10	25	194
10	65	144	36	33	20	10	25	50

Daily discharge, in second-feet, of San Pedro River at Charleston, Ariz., for 1906—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug
11	64	205	36	33	19	10	25	50
12	63	164	36	30	19	10	25	174
13	62	678	55	30	18	10	25	126
14	61	438	316	30	18	9	25	71
15	60	398	298	30	18	9	25	47
16	59	174	55	30	17	9	25	958
17	58	154	55	30	17	9	25	316
18	57	120	55	25	17	9	25	13
19	56	100	55	25	17	9	25	50
20	55	83	55	25	17	8	25	120
21	54	78	60	25	17	8	45	162
22	53	74	60	25	17	8	47	120
23	52	70	60	25	17	7	49	34
24	51	65	60	25	17	7	51	50
25	50	65	60	25	17	7	53	50
26	49	65	36	25	17	6	55	50
27	49	65	36	25	17	6	55	50
28	49	65	36	25	16	4	45	50
29	49	....	36	25	15	4	45	50
30	49	....	36	25	15	4	45	55
31	50	....	36	....	14	....	45	194

NOTE.—These discharges were obtained by the indirect method for shifting channel.

Monthly discharge of San Pedro River at Charleston, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	65	49	56.7	3,490
February	578	20	130	7,220
March	316	36	65.2	4,010
April	33	25	28.9	1,720
May	25	14	18.7	1,150
June	10	4	8.0	476
July	55	20	32.7	2,010
August	958	13	147	9,040
The period	....	....	....	29,100

SALT RIVER AT ROOSEVELT, ARIZ.

This station was established February 7, 1901. It is located at the town of Roosevelt, which is the United States Reclamation Service construction camp for the Salt River dam and reservoir, and is about 12 miles west of Livingston, Ariz. The conditions at this station are described in Water-Supply Paper No. 175, page 173, where are given also references to publications that contain data for previous years.

During September, 1906, this station was reequipped with a cable and car at a point about 500 feet below the Roosevelt dam site.

During the flood of December 3 to 5, 1906, the gage rod which had been in use since the construction on the dam was begun, was carried away. From December 3 to 15, 1906, the readings were taken on the upper gage about 1,000 feet above the dam. A new rod was established at the same location as the one carried away, on December 17, 1906, with the zero at the same elevation as the old gage.

Discharge measurements of Salt River, at Roosevelt, Ariz., by Blades, Stone, and McIntyre, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1906.	*Feet.*	*Sec.-ft.*
January 6	6.60	883	April 28	8.75	3,030
January 8	6.70	863	April 30	8.55	2,710
January 9	6.70	887	May 1	8.45	2,650
January 10	6.70	864	May 2	7.95	2,360
January 11	6.70	865	May 3	7.80	2,200
January 12	6.60	753	May 4	7.70	2,230
January 13	6.60	795	May 5	7.55	2,100
January 15	6.70	876	May 7	7.40	2,000
January 16	6.90	1,060	May 8	7.40	1,980
January 17	7.25	1,580	May 9	7.35	1,900
January 18	7.40	1,760	May 10	7.30	1,980
January 19	7.30	1,540	May 11	7.20	1,830
January 20	9.30	2,190	May 12	7.20	1,910
January 21	10.65	8,900	May 14	7.35	1,960
January 22	8.65	3,130	May 15	7.20	1,880
January 23	7.80	2,320	May 16	6.95	1,770
January 24	7.40	1,720	May 17	6.70	1,620
January 25	7.20	1,560	May 18	6.80	1,730
January 26	7.00	1,360	May 19	6.50	1,560
January 27	6.90	1,230	May 21	6.70	1,380
January 29	6.65	1,040	May 22	7.20	1,520
January 30	6.60	938	May 23	7.50	1,370
January 31	6.50	949	May 26	7.50	1,240
February 1	6.50	903	May 28	7.35	1,110
February 2	6.50	902	May 29	7.20	985
February 3	6.50	863	May 31	7.20	966
February 5	6.50	863	June 1	7.20	960
February 6	6.55	947	June 2	7.20	955
February 7	6.70	1,090	June 4	7.20	854
February 8	6.80	1,230	June 5	7.15	879
February 9	6.80	1,210	June 6	7.00	851
February 10	6.80	1,260	June 7	7.00	828
February 12	7.35	1,730	June 8	6.90	843
February 13	8.00	2,970	June 9	6.90	832
February 14	7.85	2,490	June 11	6.95	770
February 15	7.45	2,130	June 12	7.20	757
February 16	7.30	1,750	June 13	7.20	770
February 17	7.20	1,640	June 14[a]	8.40	733
February 19	7.10	1,410	June 15	8.40	642
February 20	7.05	1,370	June 19	9.30	644
February 21	7.10	1,460	June 20	9.05	603
February 23	7.20	1,540	June 21	8.90	564
February 24	7.25	1,590	June 22	8.75	533
March 5	7.15	1,650	June 23	8.55	495
March 6	7.15	1,570	June 25	8.40	404
March 7	7.10	1,530	June 26	8.35	428
March 8	7.15	1,480	June 27	8.75	422
March 9	7.15	1,490	June 29	8.20	385
March 10	7.20	1,640	July 6[b]	2.40	473
March 12	8.95	1,950	July 17[b]	2.70	812
March 16	10.80	10,200	July 31	2.40	405
March 17	10.35	7,330	August 2	2.40	427
March 19	9.65	5,530	August 4	2.40	439
March 20	9.35	4,580	August 5	2.40	457
March 21	9.25	3,560	August 8	2.60	702
March 22	9.00	3,480	August 9	3.10	1,390
March 23	9.05	3,280	August 11	2.60	768
March 24	9.20	3,650	August 13	2.50	646
March 26	11.70	10,100	August 16	2.60	650
March 28	13.35	16,800	August 18	2.60	703
March 30	10.50	8,830	August 20[c]	3.70	2,040
April 2	10.40	6,550	August 22[c]	[illegible].75	2,120
April 9	10.70	7,360	August 23[c]	[illegible]	927
April 10	10.15	5,930	August 24	2.70	730
April 11	9.95	5,500	August 27	2.60	670
April 12	9.90	5,330	August 28	2.60	887
April 13	9.75	5,690	September 1	2.50	797
April 14	9.60	4,960	September 3	2.40	635
April 16	9.40	4,710	September 14	2.30	264
April 17	9.30	4,080	September 15	2.30	372
April 18	9.30	4,040	September 17	2.40	642
April 19	9.30	3,900	September 18	2.40	438
April 20	9.30	3,990	September 18	2.40	409
April 21	9.20	3,830	September 20	2.38	323
April 23	9.3	3,840	September 21	2.30	318
April 24	9.2	3,930	September 25	2.30	286
April 25	9.2	3,960	September 28	2.40	409
April 27	9.0	3,240	September 30	2.40	434

[a] Cofferdam being filled in. [b] Measurement made by P. P. Pitchlynn. [c] Float measurements.

Discharge measurements of Salt River, at Roosevelt, Ariz., by Blades, Stone, and McIntyre, in 1906—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1906.	*Feet.*	*Sec.-ft.*	1906.	*Feet.*	*Sec.-ft.*
October 2	2.30	416	October 27	2.35	288
October 3	2.35	426	November 1	2.35	270
October 7	2.30	318	December 14	....	1,330
October 9	2.30	348	December 15	3.48	1,250
October 11	2.30	311	December 16	3.35	1,070
October 13	2.30	276	December 17	3.35	1,060
October 15	2.30	258	December 18	3.30	824
October 16	2.30	264	December 19	3.10	794
October 17	2.30	268	December 21	2.75	686
October 18	2.27	282	December 22	2.70	630
October 20	2.25	263	December 29	10.80	17,600
October 23	2.30	258			

Daily gage height, in feet, of Salt River at Roosevelt, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.7	6.5	7.2	10.3	8.45	7.2	2.3	2.4	2.5	2.3	2.35	2.58
2	6.7	6.5	7.35	10.4	7.95	7.2	2.3	2.4	2.5	2.3	2.32	3.38
3	6.7	6.5	7.35	10.3	7.8	[a]7.2	2.3	2.5	2.4	2.35	2.3	[c]25.34
4	6.6	6.5	7.2	9.95	7.7	7.2	2.3	2.4	2.4	2.3	2.28	[c]22.45
5	6.6	6.5	7.15	9.75	7.55	7.15	2.7	2.4	2.4	2.35	2.25	[c]15.26
6	6.6	6.55	7.15	9.55	[a]7.5	7.0	2.4	3.0	2.4	2.35	2.32	[c]12.1
7	6.7	6.7	7.1	11.15	7.4	7.0	2.5	2.75	2.4	2.3	2.38	7.25
8	6.7	6.8	7.15	11.8	7.4	6.9	2.4	2.6	2.4	2.3	2.22	5.57
9	6.7	6.8	7.15	10.7	7.35	6.9	2.4	3.1	2.4	2.3	2.3	5.0
10	6.7	6.8	7.2	10.15	7.3	[a]6.9	2.4	2.6	2.4	2.3	2.3	......
11	6.7	7.0	7.3	9.95	7.2	6.95	2.5	2.6	2.3	2.3	2.25	......
12	6.6	7.35	10.3	9.9	7.2	7.2	2.5	2.5	2.3	2.3	2.3	......
13	6.6	8.0	19.4	9.75	[a]7.3	7.2	2.5	2.5	2.3	2.3	2.4	......
14	6.6	7.85	17.6	9.6	7.35	[b]8.4	2.5	2.5	2.3	2.3	2.38	......
15	6.7	7.45	12.05	[a]9.5	7.2	8.65	2.4	2.5	2.3	2.28	2.3	3.48
16	6.9	7.3	10.8	9.45	6.95	8.8	2.5	2.6	2.4	2.3	2.38	3.35
17	7.25	7.2	10.35	9.3	6.7	[a]8.8	2.7	2.6	2.4	2.35	2.48	3.35
18	7.4	7.1	9.8	9.3	6.8	9.4	2.3	2.6	2.4	2.3	2.42	3.02
19	7.3	7.1	9.65	9.3	6.5	9.3	2.4	3.25	2.4	2.3	2.3	2.74
20	9.3	7.05	9.35	9.35	[a]6.5	9.05	2.4	3.7	2.4	2.25	2.28	2.72
21	10.65	7.1	9.25	9.2	6.7	8.9	2.4	3.3	2.3	2.25	2.3	2.73
22	8.65	7.1	9.0	[a]9.2	7.2	8.75	2.3	3.75	2.3	2.3	2.4	2.74
23	7.8	7.2	9.05	9.3	7.5	8.55	2.5	2.75	2.3	2.25	2.48	2.72
24	7.4	7.25	9.25	9.25	7.3	8.45	2.5	2.7	2.3	2.25	2.5	2.65
25	7.2	7.15	9.45	9.25	7	8.4	2.4	2.7	2.3	2.25	2.58	2.65
26	7.0	7.1	13.5	9.25	7.5	8.35	2.4	2.7	2.3	2.3	2.65	2.55
27	6.9	7.0	17.0	9.05	[a]7.4	8.25	2.8	2.6	2.3	2.3	2.45	2.45
28	6.8	7.0	13.25	8.75	7.35	8.2	2.7	2.6	2.3	2.3	2.38	4.78
29	6.65	....	11.4	[a]8.6	7.2	8.2	2.55	2.6	2.4	2.28	2.4	11.55
30	6.6	....	10.5	8.55	[a]7.2	8.2	2.5	2.55	2.4	2.35	2.4	9.15
31	6.5	....	10.05	....	7.2	....	2.5	2.5	....	2.3	....	7.25

[a] Gage heights estimated.
[b] Cofferdam being filled.
[c] Mean of readings at two-hour intervals.

Daily discharge, in second-feet, of Salt River at Roosevelt, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	990	903	1,610	7,950	2,652	960	385	417	797	425	270	305
2	990	903	1,730	6,547	2,365	955	385	427	797	416	267	430
3	990	863	1,730	6,685	2,201	905	385	575	635	426	265	36,600
4	880	863	1,610	5,828	2,229	854	385	427	635	399	263	33,700
5	880	863	1,648	5,337	2,096	879	765	455	635	372	260	8,800
6	883	947	1,572	4,847	2,092	850	475	1,275	635	345	267	5,200
7	920	1,092	1,534	8,767	1,997	828	570	927	635	318	275	4,000
8	863	1,234	1,481	10,518	1,982	843	475	725	635	330	257	1,900
9	887	1,236	1,488	7,362	1,899	832	475	1,415	635	348	265	1,650
10	864	1,258	1,638	5,953	1,982	815	475	715	635	315	265	1,400
11	865	1,410	1,718	5,505	1,832	770	570	715	264	311	260	1,300
12	753	1,732	6,685	5,330	1,907	757	570	575	264	290	265	1,300
13	795	2,974	35,700	5,686	1,954	770	570	645	264	276	280	1,326
14	790	2,494	30,000	4,836	1,957	733	570	575	264	267	275	1,253
15	876	2,127	11,525	4,836	1,879	634	475	575	264	260	265	1,074
16	1,065	1,747	10,220	4,834	1,774	636	570	650	642	264	275	1,055
17	1,581	1,639	7,330	4,000	1,615	638	765	650	642	275	290	1,055
18	1,761	1,406	5,950	4,000	1,734	642	300	703	409	264	290	855
19	1,537	1,406	5,530	4,000	1,562	644	400	1,500	409	264	265	675
20	2,190	1,372	4,577	4,122	1,562	603	400	2,050	409	263	263	650
21	8,904	1,459	3,565	3,833	1,378	564	400	1,560	318	263	265	665
22	3,132	1,459	3,477	3,833	1,525	533	300	2,120	310	258	280	675
23	2,321	1,543	3,277	3,841	1,373	495	525	925	302	255	290	650
24	1,716	1,588	3,770	4,050	1,170	450	525	730	294	255	295	625
25	1,561	1,485	4,602	4,080	1,287	404	400	730	286	255	305	625
26	1,360	1,430	17,233	3,967	1,245	428	400	730	327	258	318	575
27	1,227	1,320	28,188	3,359	1,236	422	875	670	368	260	285	525
28	1,170	1,320	16,361	3,026	1,110	403	760	887	409	260	275	2,800
29	1,039	....	9,380	2,825	985	385	620	887	420	258	280	19,500
30	938	....	8,834	2,708	975	367	575	875	434	285	280	13,500
31	949	....	6,925	....	966	....	575	800	....	260	....	8,850

NOTE.—These discharges were obtained by the indirect method for shifting channels. The discharge December 10 to 14 has been estimated.

Monthly discharge of Salt River at Roosevelt, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	8,900	753	1,470	90,400
February	2,970	863	1,430	79,400
March	35,700	1,481	7,770	478,000
April	10,500	2,700	5,080	302,000
May	2,650	966	1,690	104,000
June	960	367	667	39,700
July	875	300	514	31,600
August	2,120	417	868	53,400
September	797	264	466	27,700
October	426	255	300	18,400
November	318	257	275	16,400
December	36,600	305	4,950	304,000
The year	36,600	255	2,120	1,540,000

SALT RIVER NEAR ROOSEVELT, ARIZ.

The following measurements were made below the mouth of Cherry Creek by Mr. Bull, an engineer employed by J. G. White & Co., while investigating the practicability of developing power for transmission to the vicinity of Globe, Ariz.

Discharge measurements of Salt River, below the mouth of Cherry Creek, near Roosevelt, Ariz., in 1906.

Day.	June.		July.		August.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	....	....	−0.05	300	0.15	353
2	....	....	− .08	275	.28	408
3	....	....	− .07	280	.23	387
4	....	....	.00	310	.11	343
5	....	....	.61	620	.30	415
6	....	....	1.41	1,220	.74	720
7	....	....	.31	420	.43	490
8	....	....	.28	405	1.37	1,190
9	....	....	.26	395	1.32	1,150
10	....	....	.22	380	.42	480
11	....	....	.20	375	.59	605
12	....	....	.17	365	.59	608
13	....	....	.14	355	.38	455
14	....	....	.09	335	.24	390
15	....	....	.33	430	.41	475
16	....	....	1.09	980	.34	433
17	....	....	.42	480	.30	415
18	....	....	.23	387	.27	400
19	....	....	.08	335	.50	537
20	....	....	.04	325	....	....
21	....	....	.00	310	....	....
22	....	....	.03	320	....	....
23	0.24	390	.30	415	....	....
24	.19	370	.06	330	....	....
25	.15	355	.02	315	....	....
26	.12	345	.40	470	....	....
27	.19	335	.50	537	....	....
28	.05	320	.39	465	....	....
29	−.00	310	.21	375	....	....
30	−.02	305	.15	353	....	....
31	....	....	.13	345	....	....

SALT RIVER AT M'DOWELL, ARIZ.

This station was established April 20, 1897. It is located one-third mile above the junction of Salt and Verde rivers, 30 miles northeast of Phœnix, 15 miles northeast of Mesa, and 1¾ miles above the Arizona canal diversion dam. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 177, where are given also references to publications that contain data for previous years.

Discharge measurements of Salt River at McDowell, Ariz., by W. Richins, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 6	4.80	777	January 22	6.47	4,740
January 9	4.85	820	January 23	5.91	3,020
January 11	4.82	838	January 25	5.60	1,800
January 13	4.77	720	January 27	5.37	1,590
January 16	4.87	841	January 30	5.12	1,280
January 18	5.65	1,710	January 31	5.06	1,150
January 19	5.60	1,580	February 2	4.98	1,130
January 20	5.71	1,870	February 3	4.95	1,050
January 21	8.85	13,800	February 5	4.92	1,020

Discharge measurements of Salt River at McDowell, Ariz., by W. Richins, in 1906—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
February 7	5.00	1,150	July 6	2.75	366
February 9	5.23	1,630	July 10	2.95	502
February 12	5.60	1,960	July 12	2.95	504
February 14	6.00	2,900	July 14	2.80	417
February 16	5.68	2,260	July 17	3.22	718
February 20	5.25	1,800	July 20	2.85	498
February 22	5.26	1,830	July 24	2.70	421
February 24	5.28	2,040	July 26	2.75	510
February 27	5.13	1,680	July 28	3.55	957
March 1	5.20	1,770	July 31	2.95	528
March 3	5.40	1,920	August 2	3.10	608
March 6	5.16	1,630	August 7	3.10	623
March 8	5.09	1,690	August 9	3.20	675
March 10	5.05	1,530	August 11	3.30	762
March 13	12.05	35,300	August 14	3.30	709
March 14	11.90	34,100	August 17	3.50	753
March 15	9.10	21,600	August 20	5.50	2,249
March 16	7.70	10,600	August 22	5.45	2,254
March 17	7.10	7,470	August 24	3.70	726
March 19	6.66	5,440	August 28	3.55	560
March 20	6.50	4,750	August 30	3.68	663
March 22	6.25	3,860	September 3	3.40	568
March 24	6.45	3,700	September 5	3.20	483
March 26	7.95	8,270	September 7	3.15	400
March 28	9.25	20,380	September 10	3.00	326
March 30	7.62	8,790	September 12	3.00	346
April 3	7.04	5,320	September 14	2.95	318
April 5	6.78	4,320	September 17	3.20	431
April 7	7.05	5,020	September 19	3.15	385
April 9	7.55	7,690	September 21	3.10	377
April 11	6.90	5,710	September 25	2.95	302
April 13	6.80	5,580	September 28	2.90	285
April 17	6.30	4,560	October 1	3.20	380
April 19	6.08	4,540	October 3	3.10	371
April 21	6.05	4,440	October 5	3.00	340
April 24	6.13	4,530	October 9	2.90	303
April 26	6.03	4,240	October 12	2.85	278
April 28	5.60	3,390	October 16	2.85	287
May 1	5.17	3,010	October 19	2.80	291
May 3	5.15	2,440	October 23	2.80	278
May 5	5.10	2,060	October 26	2.85	284
May 8	5.00	2,110	October 29	2.90	297
May 10	4.90	1,830	October 31	2.95	329
May 12	4.75	1,580	November 2	2.95	344
May 15	4.75	1,680	November 7	3.00	367
May 17	4.50	1,500	November 9	3.00	372
May 18	4.45	1,490	November 13	2.95	342
May 22	4.25	1,340	November 16	2.90	326
May 24	4.15	1,280	November 20	2.85	310
May 25	4.05	1,190	November 23	2.95	339
May 29	3.75	920	November 26	3.35	611
May 31	3.70	978	November 28	3.15	479
June 2	3.65	930	November 30	3.10	451
June 5	3.60	881	December 4	11.15	27,700
June 7	3.45	765	December 6	6.70	7,090
June 9	3.40	721	December 8	6.40	2,860
June 12	3.35	742	December 11	5.60	1,830
June 15	3.30	698	December 14	5.00	1,430
June 19	3.20	602	December 18	4.65	934
June 21	3.10	563	December 21	4.40	735
June 23	3.00	475	December 26	4.20	650
June 26	2.85	404	December 28	7.80	8,550
June 29	2.75	359	December 29	10.95	24,900
July 3	2.65	342	December 31	6.75	7,020

Daily gage height, in feet, of Salt River at McDowell, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.97	5.01	5.20	[b]7.35	5.20	3.70	2.75	3.18	3.55	3.20	2.90	3.10
2	4.93	4.97	5.33	7.28	5.22	3.65	2.65	3.05	3.48	3.18	2.95	4.75
3	4.92	[a]4.95	[a]5.40	7.04	5.18	[b]3.65	2.65	3.05	3.42	3.10	2.95	7.25
4	4.88	[b]4.95	[b]5.34	6.92	5.12	3.60	2.65	3.05	3.30	3.05	2.95	11.90
5	4.85	4.92	5.28	6.79	[a]5.10	3.58	2.60	3.00	3.20	2.98	2.95	8.05
6	[a]4.80	4.94	5.20	6.71	[b]5.05	3.52	2.70	2.98	3.20	2.95	2.95	6.80
7	[b]4.80	5.02	5.11	7.22	5.05	3.45	2.75	3.10	3.15	2.90	3.00	6.60
8	4.80	5.18	5.10	8.25	5.00	3.42	3.20	3.58	3.10	2.90	3.00	6.35
9	4.85	5.24	5.08	7.58	4.95	3.40	3.00	3.60	3.05	2.90	3.00	6.15
10	4.85	[a]5.18	[a]5.05	7.18	4.90	[b]3.40	2.92	3.68	3.00	2.90	3.00	5.95
11	4.82	5.28	[b]5.15	6.88	4.85	3.35	2.92	3.30	2.98	2.85	2.98	5.45
12	4.79	5.58	5.25	6.80	[a]4.75	3.35	2.90	3.30	3.00	2.85	2.95	5.22
13	4.77	6.18	12.40	6.78	[b]4.75	3.32	2.80	3.35	2.98	2.85	2.95	5.08
14	[b]4.78	6.05	12.10	[a]6.65	4.80	3.30	2.80	3.30	2.95	2.85	2.90	5.00
15	4.79	5.82	9.10	[b]6.50	4.75	3.30	2.80	3.22	2.90	2.85	2.90	5.00
16	4.91	5.68	7.70	6.42	4.62	3.30	2.90	3.88	3.05	2.85	2.90	4.90
17	5.20	[a]5.52	7.05	6.26	4.50	[b]3.25	3.30	3.48	3.20	2.80	2.90	4.78
18	5.62	[b]5.45	6.76	6.12	4.45	3.20	3.20	3.40	3.20	2.80	2.88	4.62
19	5.50	5.38	6.66	6.08	[a]4.40	3.18	2.98	4.15	3.12	2.80	2.85	4.55
20	5.90	5.26	6.50	6.16	[b]4.35	3.12	2.82	5.25	3.10	2.80	2.85	4.50
21	8.40	5.26	6.32	[a]6.10	4.28	3.08	2.75	4.75	3.10	2.80	2.90	4.40
22	6.35	5.26	6.31	[b]6.05	4.22	3.05	2.70	5.40	3.10	2.80	2.90	4.35
23	5.88	5.26	6.44	6.00	4.18	3.00	2.62	4.65	3.02	2.80	2.95	4.30
24	5.65	[a]5.28	[a]6.45	6.06	4.12	[b]2.95	2.75	3.70	2.95	2.80	3.10	4.25
25	5.50	[b]5.25	[a]6.50	6.06	4.08	2.90	2.80	3.65	2.92	2.85	3.35	4.20
26	5.45	5.21	7.90	5.96	[a]4.05	2.85	2.80	3.60	2.90	2.85	3.35	4.20
27	[a]5.37	5.12	11.40	5.72	[b]3.95	2.80	3.05	3.55	2.90	2.85	3.25	4.15
28	[b]5.35	5.10	9.25	[a]5.60	3.88	2.78	3.55	3.52	2.90	2.90	3.12	6.10
29	5.20	......	8.18	[b]5.40	3.75	2.78	3.25	3.95	2.90	2.90	3.10	11.45
30	5.11	......	7.60	5.28	3.70	2.75	3.05	3.72	2.90	2.90	3.10	8.20
31	5.06	......	[a]7.40	......	3.70	......	2.92	3.55	......	2.92	......	6.70

[a] One reading. [b] Gage height interpolated.

Daily discharge, in second-feet, of Salt River at McDowell, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	950	1,130	1,767	7,150	3,065	970	398	663	600	380	325	450
2	910	1,120	1,010	6,600	2,845	937	342	585	565	378	350	962
3	900	1,045	1,920	5,325	2,460	937	342	585	580	370	350	6,300
4	868	1,045	1,855	4,850	2,109	885	342	585	520	357	350	38,000
5	830	1,015	1,789	4,321	2,058	868	315	555	483	335	350	12,700
6	780	1,050	1,705	4,000	2,046	817	370	544	460	320	350	7,500
7	780	1,160	1,716	5,850	2,140	760	398	615	400	305	370	5,200
8	780	1,460	1,705	11,150	2,113	736	700	1,006	375	305	370	2,700
9	830	1,640	1,632	7,800	1,970	720	555	1,023	350	305	370	2,450
10	830	1,470	1,530	6,560	1,826	720	499	1,093	325	305	370	2,227
11	800	1,500	1,652	5,680	1,744	688	499	762	330	278	365	1,650
12	770	1,840	1,758	5,550	1,579	742	485	800	346	280	350	1,500
13	750	3,540	37,290	5,543	1,605	720	425	855	340	282	350	1,400
14	760	3,098	35,300	5,277	1,680	705	425	840	318	284	325	1,425
15	770	2,540	21,385	4,971	1,684	698	425	775	295	286	325	1,350
16	800	2,264	10,590	4,809	1,560	690	485	1,040	375	287	325	1,250
17	1,180	2,020	7,245	4,560	1,502	650	775	735	425	295	325	1,100
18	1,600	2,010	5,830	4,548	1,492	615	720	680	425	290	315	925
19	1,510	1,950	5,480	4,545	1,435	583	575	1,240	385	290	300	825
20	2,558	1,810	4,754	4,551	1,400	565	475	2,065	375	288	300	800
21	12,016	1,810	4,090	4,547	1,350	550	435	1,690	375	286	325	750
22	4,240	1,828	4,050	4,443	1,318	520	415	2,210	375	284	325	725
23	2,808	1,930	4,014	4,393	1,294	475	375	1,535	335	278	350	700
24	2,000	2,087	3,700	4,375	1,250	452	445	725	305	276	430	675
25	1,770	2,020	3,275	4,320	1,216	430	520	670	293	284	610	650
26	1,610	1,960	7,900	4,110	1,170	408	545	630	285	284	610	650
27	1,587	1,660	28,200	3,630	1,090	385	660	575	285	284	530	640
28	1,540	1,570	16,566	3,388	1,020	376	962	535	285	296	440	2,490
29	1,380	......	11,330	3,180	920	376	738	905	285	296	430	31,900
30	1,260	......	8,772	3,070	940	362	592	705	285	296	430	12,600
31	1,148	......	7,472	......	978	......	499	560	......	310	......	6,900

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Salt River at McDowell, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	12,000	750	1,660	102,000
February	3,540	1,020	1,770	98,300
March	37,300	1,530	8,010	493,000
April	11,200	3,070	5,100	303,000
May	3,060	920	1,640	101,000
June	970	362	645	38,400
July	962	315	508	31,200
August	2,210	535	896	55,100
September	600	285	379	22,600
October	380	276	303	18,600
November	610	300	377	22,400
December	38,000	450	4,820	296,000
The year	38,000	276	2,180	1,580,000

VERDE RIVER AT M'DOWELL, ARIZ.

This station was established April 20, 1897. It is located 30 miles northeast of Phœnix, 15 miles northeast of Mesa, 2½ miles above the Arizona Canal diversion dam, and three-fourths mile above the mouth of the river. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 181, where are given also references to publications that contain data for previous years.

Discharge measurements of Verde River at McDowell, Ariz., by W. Richins, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 5	3.60	482	March 24	5.20	1,290
January 9	3.60	447	March 26	12.25	20,700
January 11	3.56	483	March 27[a]	15.20	37,500
January 13	3.56	472	March 28	10.10	13,700
January 16	3.56	490	March 30	6.35	3,790
January 18	3.95	715	April 3	4.10	1,460
January 19	4.30	995	April 5	3.75	1,160
January 20	4.45	1,050	April 7	3.85	1,180
January 21	6.90	3,750	April 9	5.00	2,690
January 22	5.80	2,780	April 11	4.60	1,800
January 23	5.20	1,580	April 13	3.90	1,150
January 25	4.50	979	April 17	3.03	762
January 27	4.20	750	April 19	2.83	637
January 30	3.92	621	April 21	2.70	549
January 31	3.86	577	April 24	2.43	466
February 2	3.76	553	April 26	2.40	403
February 3	3,75	499	April 28	2.50	372
February 5	3.76	522	May 1	2.48	336
February 7	3.92	690	May 3	2.47	331
February 9	4.45	1,090	May 5	2.47	310
February 12	5.00	1,440	May 8	2.50	280
February 14	5.50	1,790	May 10	2.40	261
February 16	5.53	1,880	May 12	2.40	256
February 20	5.25	1,600	May 15	2.40	212
February 22	5.25	1,670	May 17	2.35	217
February 24	4.90	1,390	May 18	2.35	212
February 27	4.45	943	May 22	2.35	197
March 1	4.45	927	May 24	2.30	188
March 3	4.70	1,130	May 25	2.30	191
March 6	4.17	743	May 29	2.30	212
March 8	4.05	610	May 31	2.30	193
March 11	3.95	539	June 2	2.30	196
March 13	8.70	7,710	June 5	2.30	194
March 14[a]	14.65	31,600	June 7	2.25	176
March 15	10.70	15,520	June 9	2.25	170
March 16	8.95	6,010	June 12	2.20	149
March 17	7.90	3,520	June 15	2.20	163
March 19	7.00	3,380	June 19	2.10	124
March 20	6.40	2,240	June 21	2.10	134
March 22	5.60	1,440	June 23	2.10	122

[a] Float measurement.

Discharge measurements of Verde River at McDowell, Ariz., by W. Richins, in 1906—Cont'd.

Date.	Gage height.	Dis-charge.	Date.	Gage height.	Dis-charge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
June 26	2.05	118	September 28	2.35	131
June 29	2.05	121	October 1	2.40	146
July 3	2.05	105	October 3	2.40	182
July 6	2.25	151	October 5	2.40	161
July 10	2.25	181	October 9	2.40	150
July 12	2.30	186	October 12	2.45	174
July 14	2.30	185	October 16	2.45	191
July 17	2.40	254	October 19	2.45	174
July 20	2.40	223	October 23	2.45	180
July 24	2.25	188	October 26	2.50	215
July 26	2.52	268	October 29	2.55	226
July 28	3.05	604	October 31	2.60	246
July 31	2.60	305	November 2	2.60	266
August 2	2.65	353	November 7	2.65	284
August 7	3.00	511	November 9	2.65	278
August 9	2.85	414	November 13	2.65	274
August 11	2.95	438	November 16	2.65	273
August 14	2.95	409	November 20	2.65	288
August 17	3.00	480	November 23	2.70	298
August 20	5.00	2,400	November 26	3.00	518
August 22	4.90	2,250	November 28	2.95	405
August 24	3.50	855	November 30	2.85	373
August 28	2.90	384	December 4	12.40	19,800
August 30	3.08	554	December 6	6.05	3,750
September 3	2.80	304	December 8	4.00	1,600
September 5	2.70	320	December 11	3.50	976
September 7	2.65	258	December 14	4.35	1,340
September 10	2.55	218	December 18	3.00	702
September 12	2.55	213	December 21	2.65	540
September 14	2.50	200	December 26	2.45	420
September 17	2.45	169	December 28	2.60	571
September 19	2.45	177	December 29	11.00	13,000
September 21	2.50	177	December 31	6.50	4,030
September 25	2.40	155			

Daily gage height, in feet, of Verde River at McDowell, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.61	3.80	4.48	[b] 4.90	2.53	2.30	2.05	2.98	2.90	2.40	2.60	3.23
2	3.59	3.76	4.68	4.40	2.53	2.30	2.05	2.60	2.85	2.38	2.60	4.92
3	3.58	[a] 3.75	[a] 4.70	4.05	2.52	2.30	2.05	2.90	2.80	2.40	2.60	8.60
4	3.59	[b] 3.75	[b] 4.50	3.92	2.52	2.30	2.05	3.70	2.75	2.40	2.60	11.50
5	3.60	3.75	4.30	3.75	[a] 2.47	2.30	2.05	3.40	2.70	2.40	2.60	8.90
6	[a] 3.55	3.74	4.14	3.70	[b] 2.50	2.30	2.38	3.08	2.70	2.35	2.60	5.75
7	[b] 3.55	3.96	4.10	3.92	2.52	2.25	2.25	2.98	2.65	2.40	2.65	4.80
8	3.55	4.19	4.05	4.20	2.50	2.25	2.25	2.90	2.65	2.40	2.65	3.95
9	3.60	4.48	3.98	5.10	2.45	2.25	2.20	2.85	2.60	2.40	2.65	3.90
10	3.60	[a] 4.45	[a] 3.95	5.20	2.40	2.20	2.25	2.75	2.58	2.40	2.65	3.55
11	3.57	4.68	[b] 4.00	4.50	2.40	2.20	2.28	2.95	2.55	2.42	2.65	3.48
12	3.56	4.98	4.10	4.08	[a] 2.40	2.20	2.30	3.00	2.52	2.45	2.65	3.40
13	3.56	5.15	11.30	3.65	[b] 2.40	2.20	2.30	3.00	2.50	2.45	2.65	3.35
14	[b] 3.55	5.48	14.60	[a] 3.50	2.40	2.20	2.30	2.92	2.50	2.45	2.65	4.35
15	3.55	5.75	10.35	[b] 3.30	2.40	2.20	2.30	2.78	2.50	2.45	2.65	3.95
16	3.58	5.43	8.70	3.14	2.40	2.20	2.25	3.48	2.45	2.45	2.65	3.50
17	3.66	[a] 5.40	7.70	2.99	2.35	2.15	2.40	3.05	2.45	2.45	2.65	3.15
18	4.01	[b] 5.35	7.90	2.92	2.35	2.12	2.45	3.00	2.45	2.45	2.65	2.98
19	4.30	5.30	7.00	2.82	[a] 2.35	2.10	2.42	4.02	2.45	2.45	2.65	2.80
20	4.42	5.18	6.40	2.75	[b] 2.35	2.10	2.38	5.05	2.48	2.45	2.65	2.72
21	6.85	5.18	5.90	[a] 2.70	2.35	2.10	2.35	4.80	2.48	2.45	2.65	2.65
22	5.75	5.12	5.50	[b] 2.60	2.32	2.10	2.32	4.65	2.45	2.45	2.65	2.60
23	5.10	5.00	5.25	2.53	2.30	2.10	2.28	3.82	2.40	2.45	2.70	2.55
24	4.72	[a] 4.90	5.20	2.46	2.30	2.10	2.22	3.42	2.40	2.50	2.85	2.50
25	4.45	[b] 4.75	[a] 5.40	2.45	2.30	2.05	2.22	3.25	2.40	2.50	3.00	2.45
26	4.28	4.63	12.40	2.42	[a] 2.30	2.05	2.90	3.10	2.35	2.50	3.00	2.45
27	[a] 4.20	4.42	14.40	2.47	[b] 2.30	2.05	2.95	2.98	2.38	2.50	2.95	2.42
28	[b] 4.10	4.35	9.85	[a] 2.50	2.30	2.05	3.05	2.88	2.35	2.52	2.92	4.02
29	3.98	......	7.90	[b] 2.50	2.30	2.05	2.88	2.85	2.35	2.55	2.90	10.65
30	3.90	......	6.15	2.49	2.30	2.05	2.72	3.05	2.35	2.55	2.85	8.05
31	[a] 3.86	......	[a] 5.30	......	2.30	......	2.58	3.02	......	2.60	......	6.15

[a] One reading.

[b] Gage height interpolated.

Daily discharge, in second-feet, of Verde River at McDowell, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	489	560	984	2,280	380	195	109	495	385	145	266	855
2	482	544	1,144	1,770	380	195	107	355	340	160	266	2,600
3	478	500	1,160	1,410	370	195	105	470	310	180	266	8,200
4	482	513	1,000	1,300	365	195	105	1,150	312	170	266	15,450
5	485	518	840	1,158	310	195	105	850	320	160	266	8,800
6	468	570	718	1,100	300	195	195	590	320	147	266	3,400
7	468	700	665	1,235	315	178	158	495	260	155	280	2,390
8	468	900	610	1,700	280	174	166	420	260	153	280	1,450
9	477	1,105	560	2,770	270	170	173	370	235	150	280	1,425
10	485	1,050	539	2,680	261	153	181	345	220	150	280	1,050
11	486	1,195	574	1,700	258	151	183	440	215	160	280	950
12	480	1,400	643	1,315	256	149	186	480	213	175	280	900
13	472	1,520	12,000	975	240	154	186	480	200	179	280	875
14	480	1,770	31,300	910	225	158	186	390	200	183	280	1,340
15	485	2,130	14,450	820	212	163	186	375	200	186	280	1,150
16	495	1,770	5,090	785	215	163	190	840	170	190	280	950
17	562	1,780	3,340	715	217	143	254	520	170	185	280	790
18	770	1,700	3,925	675	212	130	260	480	173	180	280	700
19	995	1,650	3,377	637	209	124	237	1,370	177	175	280	625
20	1,030	1,530	2,240	570	205	124	215	2,465	180	175	280	590
21	3,679	1,582	1,712	550	201	124	213	2,150	178	175	280	550
22	2,710	1,570	1,395	510	195	124	205	2,000	170	175	280	530
23	1,510	1,480	1,300	495	190	124	198	1,170	150	180	295	500
24	1,176	1,392	1,287	470	188	124	185	855	150	200	355	475
25	960	1,200	1,350	450	191	120	185	670	150	207	520	450
26	824	1,140	21,375	415	195	120	420	560	130	215	520	450
27	760	936	30,450	385	200	117	555	465	145	210	450	430
28	690	880	12,950	372	205	115	604	385	130	205	408	1,200
29	632	....	7,100	360	212	113	495	340	130	225	380	12,300
30	600	....	2,536	350	203	111	395	535	130	225	355	7,100
31	584	....	2,690		193	....	305	495	.....	245	.....	3,350

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Verde River at McDowell, Ariz., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	3,680	468	812	49,900
February	2,130	500	1,200	66,600
March	31,300	539	5,460	336,000
April	2,770	350	1,030	61,300
May	380	188	247	15,200
June	195	111	150	8,930
July	604	105	234	14,400
August	2,460	340	743	45,700
September	385	130	211	12,600
October	245	145	181	11,100
November	520	266	312	18,600
December	15,400	430	2,640	162,000
The year	31,300	105	1,100	802,000

SANTA CRUZ RIVER AND DITCHES AT TUCSON, ARIZ.

This station was established October 15, 1905, by G. E. P. Smith. It is located at Congress Street Bridge, Tucson, Ariz. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 185.

Manning and Farmers ditches divert practically the entire flow during the low period of Santa Cruz River. These ditches are taken out just above the gaging station, and their flow is determined by current-meter measurements, supplemented by daily records kept by the ditch management, as to the amount of water contained in each. This water is used to irrigate lands on the north and south sides of Santa Cruz River in and about the vicinity of Tucson.

Discharge measurements of Santa Cruz River at Tucson, Ariz., by G. E. P. Smith, in 1905–6.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1905.	*Feet.*	*Sec.-ft.*	1906.	*Feet.*	*Sec.-ft.*
November 27	1.58	251	February 13	2.65	1,170
November 28	3.60	2,520	February 13	2.55	1,020
December 27	.72	40	February 14	2.00	583
			February 15	1.62	380
1906.			March 28	.25	.3
January 17	.80	9.2	July 25[a]	.80	25
February 5	.94	15	August 20	.63	25
February 12	3.25	1,750	December 3	1.50	275

[a] Float measurement.

Discharge measurements of ditches near Tucson, Ariz., by G. E. P. Smith, in 1906.

Date.	Ditch.	Discharge.	Date.	Ditch.	Discharge.
		Sec.-ft.			*Sec.-ft.*
March 28	Farmers	[a] 2.8	July 29	Manning	4.2
March 28	Manning	10.4	August 4 [b]	do	4.5
April 29	do	10.9	August 4 [c]	do	4.6
May 27	do	13.0	August 5	Farmers	4.0
June 10	Farmers	5.3	August 26	do	4.2
July 29	do	4.2	August 26	Manning	5.7

[a] Three-fourths of the discharge was used above point of measurement; total discharge of both ditches, about 20 second-feet.

[b] 2 p. m.

[c] 4 p. m.

Daily gage height, in feet, of Santa Cruz River at Tucson, Ariz., for 1906.

Day.	Jan.	Feb.	March.	Dec.	Day.	Jan.	Feb.	March.	Dec.
1	0.80		0.80		17	0.80	1.30	1.20	
2	.80		.80	0.70	18	.80	1.00		
3	.80		.80	1,80	19	.80	1.00		
4	.80			.70	20	.80	1.00		
5	.80	0.94			21	.80	1.00		
6	.80	.94			22	.80	1.00		
7	.80	.94			23	.80	1.00		
8	.80	.94			24	.80	1.00		
9	.80	.94			25	.80	.80		
10	.80	.94			26	.80	.80		
11	.80	.90			27	.80	.80		0.50
12	.80	3.10			28	.80	.80		.75
13	.80	2.75			29	.80			.80
14	.80	2.15			30	.80			.85
15	.80	1.65	1.20		31	.80			.70
16	.80	1.35	1.20						

Daily discharge, in second-feet, of Santa Cruz River at Tucson, Ariz., for 1905–6.

Day.	1905.		1906.				Day.	1905.		1906.			
	Nov.	Dec.	Jan.	Feb.	Mar.	Dec.		Nov.	Dec.	Jan.	Feb.	Mar.	Dec.
1	......	40	10	......	10	......	17	10	40	10	170	340	10
2	......	40	10	......	10	35	18	10	40	10	40	...	10
3	......	40	10	......	10	820	19	10	40	10	40	..	10
4	......	40	10	......	......	35	20	10	40	10	40	..	10
5	......	40	10	25	......	10	21	10	40	10	40	.	10
6	......	40	10	25	......	10	22	350	40	10	40	...	10
7	......	40	10	25	......	10	23	125	35	10	40		10
8	350	40	10	25	......	10	24	580	35	10	40		10
9	150	40	10	25	......	10	25	170	30	10	10		10
10	......	40	10	25	......	10	26	75	30	10	10	.	10
11	......	40	10	20	......	10	27	210	25	10	10	..	10
12	......	40	10	1,575	......	10	28	3,200	20	10	10	.	50
13	......	40	10	1,225	......	10	29	925	20	10	....		75
14	......	40	10	710	....	10	30	250	15	10		..	50
15	......	40	10	350	340	10	31	.	15	10	.		35
16	......	40	10	190	340	10							

Note.—These discharges were obtained by the indirect method for shifting channels. The river was dry on days when discharge is not given.

Monthly discharge of Santa Cruz River and ditches at Tucson, Ariz., for 1905–6.

Month.	Discharge in second-feet.			Acre-feet.			
	Maximum.	Minimum.	Mean.	River.	Farmers ditch.	Manning ditch.	Total.
1905.							
November	3,200	0	215	12,800	134	308	13,200
December	40	15	35.6	2,190	0	0	2,190
1906							
January	10	10	10.0	615	290	0	905
February	1,580	0	168	9,330	221	159	9,710
March	340	0	33.9	2,080	420	496	3,000
April	....	....	.0	0	371	661	1,030
May	....	....	.0	0	229	694	923
June	....	....	.0	0	318	508	826
July	....	....	.0	0	231	324	555
August	....	....	.0	0	179	386	565
September	....	....	.0	0	224	390	614
October	....	....	.0	0	263	423	686
November	....	....	.0	0	182	513	695
December	820	0	42.0	2,640	88	438	3,170
The year	....	....	....	14,700	3,020	4,600	22,300

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Water-Supply Paper No. 212

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

SURFACE WATER SUPPLY
OF THE
GREAT BASIN DRAINAGE
1906

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E. C. LA RUE, THOMAS GRIEVE, JR.
AND HENRY THURTELL
DISTRICT HYDROGRAPHERS

WASHINGTON
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1908

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SURFACE WATER SUPPLY OF THE GREAT BASIN DRAINAGE 1906.[a]

E. C. La Rue, Thomas Grieve, Jr., and Henry Thurtell,
District hydrographers.

INTRODUCTION.

SCOPE OF WORK.

The water supply of the United States is of more importance to the life and pursuits of the people than any other natural resource. In the arid States the limit of agricultural development is determined by the amount of water available for irrigation, while in all parts of the country the increase in the population of cities and towns makes necessary additional water supplies for domestic and industrial uses, in procuring which both the quantity and the quality of the water that may be obtained must be considered. The location of manufacturing plants may depend largely on the water-power facilities and on the character of the water. The notable advances made in the electric transmission of power have led to the utilization of water powers for the operation of manufacturing establishments, railroads, and municipal lighting plants, many of which are at some distance from the places at which the power is developed.

The intelligent establishment and maintenance of enterprises or industries that depend on the use of water demands a thorough knowledge of the flow of the streams and an understanding of the conditions affecting that flow. This knowledge should be based on data showing both the total flow and the distribution of the flow throughout the year, in order that normal fluctuations may be provided for. As the flow of a stream is variable from year to year, estimates of future flow can be made only from a study of observations covering several years. The rapid increase in the development of the water resources of the United States has caused a great demand by engine for information in regard to the flow of streams, as it is now genera realized that the failure of many large power, irrigation, and oth projects has been due to the fact that the plans were made witho sufficient trustworthy information in respect to the water supply.

---

[a] This report contains information similar to that published for previous years under the title "Report of Progress of Stream Measurements."

Owing to the broad scope of these hydrographic investigations an the length of time they should cover in order that the records may b of greatest value, it is in general impossible for private individuals t collect the necessary data, and as many of the streams traverse mor than one State this work does not properly fall within the province o the State authorities. The United States Geological Survey has, therefore, by means of specific appropriations by Congress, for several years systematically made records of stream flow, with the view of ultimately determining all the important features governing the flow of the principal streams of the country. In carrying out this plan stations are established on the streams and maintained for a period long enough to show their regimen or general behavior. When a record that is sufficient for this purpose has been obtained for any stream, the work on that stream is discontinued. The order in which the streams are measured is determined by the degree of their importance.

During 1906 the regimen of flow was studied at about 700 stations distributed along the various rivers throughout the United States, as shown on Pl. I. In addition to these records data in regard to precipitation, evaporation, water power, and river profiles were obtained in many sections of the country.

These data have been assembled by drainage areas and are published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 201 to 214, inclusive, each of which pertains to the surface water resources of a group of adjacent areas. In these papers are embodied not only the data collected in the field, but also the results of computations based on these data and other information that has a direct bearing on the subject, such as descriptions of basins and the streams draining them, utility of the water resources, etc. The list follows.

Water-Supply and Irrigation Papers on surface water supply, 1906.

201. Surface water supply of New England, 1906. (Atlantic coast of New England drainage.)
202. Surface water supply of the Hudson, Passaic, Raritan, and Delaware river drainages, 1906.
203. Surface water supply of the Middle Atlantic States, 1906. (Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.)
204. Surface water supply of the Southern Atlantic and Eastern Gulf States, 1906. (Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages.)
205. Surface water supply of the Ohio and lower eastern Mississippi river drainages, 1906.

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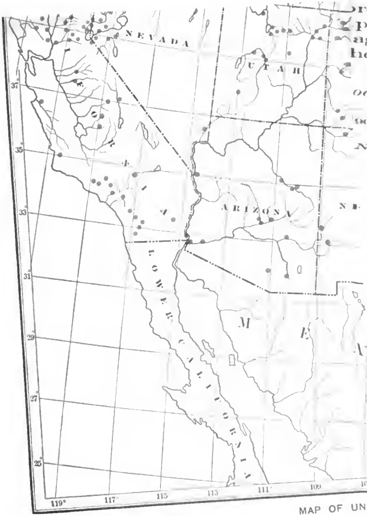

MAP OF UNIT

206. Surface water supply of the Great Lakes and St. Lawrence River drainages, 1906.
207. Surface water supply of the upper Mississippi River and Hudson Bay drainages, 1906.
208. Surface water supply of the Missouri River drainage, 1906.
209. Surface water supply of the lower western Mississippi River drainage, 1906.
210. Surface water supply of the western Gulf of Mexico and Rio Grande drainages, 1906.
211. Surface water supply of the Colorado River drainage above Yuma, 1906.
212. Surface water supply of the Great Basin drainage, 1906.
213. Surface water supply of California, 1906. (The Great Basin and Pacific Ocean drainages in California and Colorado River drainage below Yuma.)
214. Surface water supply of the North Pacific Coast, 1906.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing such records up to and including 1903 has been published in Water-Supply Paper No. 119. The following table gives, by years and primary drainage basins, the numbers of the papers on surface water supply published from 1901 to 1906:

Numbers of Water-Supply Papers containing results of stream measurements, 1901–1906.[a]

	1901.	1902.	1903.	1904.	1905.	1906.
	No.	*No.*	*No.*	*No.*	*No.*	*No.*
Atlantic coast of New England drainage	65 75	82	97	124	165	201
Hudson, Passaic, Raritan, and Delaware river drainages	65 75	82	97	125	166	202
Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages	65 75	82 83	97 98	126	167	203
Santee, Savannah, Ogeechee, and Altamaha rivers and eastern Gulf of Mexico drainages	65 75	83	98	127	168	204
Ohio and lower eastern Mississippi river drainages	65 75	83	98	128	169	205
Great Lakes and St. Lawrence River drainages	65	83	97	129	170	206
Hudson Bay and upper eastern and western Mississippi River drainages	65 66 75	83 84 85	98 99 100	128 130	171	207
Missouri River drainage	66 75	84	99	130 131	172	208
Meramec, Arkansas, Red, and lower western Mississippi river drainages	66 75	84	99	131	173	209
Western Gulf of Mexico and Rio Grande drainages	66 75	84	99	132	174	210
Colorado River drainage, above Yuma	66 75	85	100	133	175	211
The Great Basin drainage	66 75	85	100	133	176	212
The Great Basin and Pacific Ocean drainages in California, and Colorado River drainage, below Yuma	66 75	85	100	134	177	213
North Pacific Coast drainage	66 75	85	100	135	178	214

[a] Reports containing data for years prior to 1901 are noted in the series list at the end of this paper.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water.

as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot: One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION AND USE OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of monthly and yearly discharges and run-off.
6. Tables showing discharge and horsepower and the number of days during the year when the same are available.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of the hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The discharge measurements and gage heights are the base data from which the other tables are computed. In cases of extensive development it is expected that engineers will use these original data in making their calculations, as the computations made by the Survey are based on the data available at the time they are made and should be reviewed and, if necessary, revised when additional data are available.

The rating table gives the discharge in second-feet corresponding to various stages of the river as given by the gage heights. It is published to enable engineers to determine the daily discharge in case this information is desired.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the remaining columns, which are defined on page 4, are based.

The values in the table of monthly discharge are intended to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

In most work where data in regard to flow are used the regimen of flow is of primary importance. Therefore for the principal stations tables have been prepared showing the horsepower that can be developed at various rates of flow, and the length of time that these rates of flow and the corresponding horsepower are available. These tables have been prepared on a basis of 80 per cent efficiency on the turbines, and the horsepower per foot of fall is given in order that the reader can determine the horsepower for any fall.

In the computations sufficient significant figures have been used so that the percentage of error in the tables will not in general exceed 1 per cent. Therefore, most of the values in the tables are given to only three significant figures. In making the various computations Thatcher's slide rule, Crelle's tables, and computation machines have been generally used.

In order to give engineers an idea of the relative value of the various data notes in regard to accuracy are given as far as possible. This accuracy depends on the general local conditions at the gaging stations and the amount of data collected. Every effort possible is made to so locate the stations that the data collected will give a high degree of accuracy. This is not always possible, but it is considered better to publish rough values with explanatory notes rather than no data.

In the accuracy notes the following terms have been used, indicating the probable accuracy, in per cent, of the mean monthly flow. As these values are mean values, the error in the value for the flow of any individual day may be much larger.

Excellent indicates that the mean monthly flow is probably accurate to within 5 per cent; good, to within 10 per cent; fair, to within 15 per cent; approximate, to within 25 per cent.

CONVENIENT EQUIVALENTS.

Following is a table of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.

1 second-foot equals 6.23 British imperial gallons per second.

1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.

1 second-foot for one year equals 31,536,000 cubic feet.

1 second-foot equals about 1 acre-inch per hour.

1 second-foot for one day covers 1 square mile 0.03719 inch deep.

1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.

1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.

1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.

1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.

1 second-foot for one day equals 1.983 acre-feet.

1 second-foot for one 28-day month equals 55.54 acre-feet.

1 second-foot for one 29-day month equals 57.52 acre-feet.

1 second-foot for one 30-day month equals 59.50 acre-feet.

1 second-foot for one 31-day month equals 61.49 acre-feet.

100 California miner's inches equal 18.7 United States gallons per second.

100 California miner's inches equal 96.0 Colorado miner's inches.

100 California miner's inches for one day equal 4.96 acre-feet.

100 Colorado miner's inches equal 2.60 second-feet.

100 Colorado miner's inches equal 19.5 United States gallons per second.

100 Colorado miner's inches equal 104 California miner's inches.

100 Colorado miner's inches for one day equal 5.17 acre-feet.

100 United States gallons per minute equal 0.223 second-feet.

100 United States gallons per minute for one day equal 0.442 acre-foot.

1,000,000 United States gallons per day equal 1.55 second-feet.

1,000,000 United States gallons equal 3.07 acre-feet.

1,000,000 cubic feet equal 22.95 acre-feet.

1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel. realizing 80 per cent of theoretical power.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief descriptions are given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; and (3) those with constantly shifting beds. In determining the daily flow special methods are necessary for each class. The data on which the determinations are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir, (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v = c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable measurements of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q = c\ b\ h^{3/2}$, or some similar standard weir formula, are known (see Water-Supply Papers Nos. 180 and 200[a]); (*f*) either no flashboards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such determinations of flow, the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the determinations of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

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[a] Water-Supply Paper No. 200 replaces No. 150, the edition of which has been exhausted.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the water surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. Their essential requirements are practically the same, whether the velocity is determined by meters or floats. They are located, as far as possible, where the channel is straight both above and below the gaging-section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and of dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats, as indicated by the distances from the bank, as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

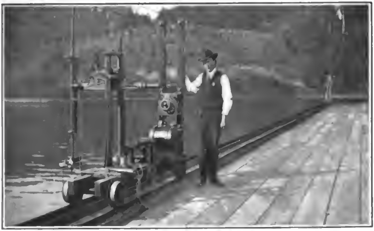
The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

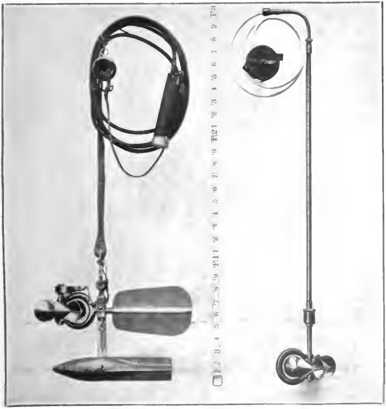
Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, shown in Pl. II, *B*, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points, and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing



A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.



B. PRICE CURRENT METERS.

in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity-curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

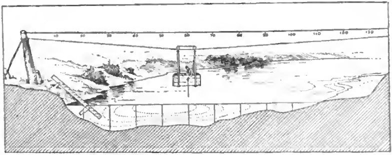


FIG. 1.—Cable station, showing section of river, car, gage, etc.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions, and moreover the indications are that it holds nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements, or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement, the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8, and vertical velocity-curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice. For information in regard to flow under ice cover see Water-Supply Paper No. 187.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of determining run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and the assumed coefficient the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant; (2) the discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected; (3) the discharge is a function of and increases gradually with the stage.

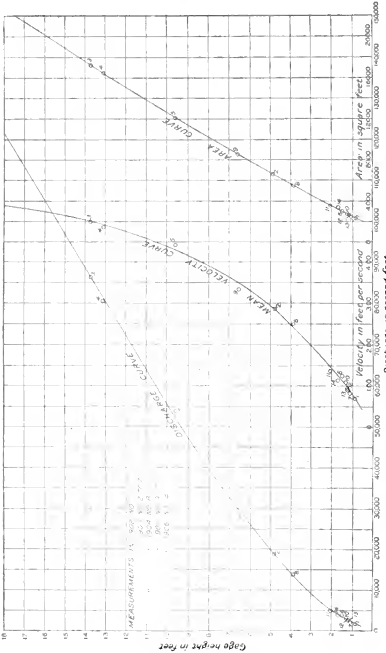


FIG. 2.—Discharge, area, and mean-velocity curves for Potomac River at Point of Rocks, Md.

The plotting of results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, the discharge can be determined by its use. In case of velocity-area stations frequent discharge measurements must be made if the determinations of flow are to be other than rough approximations. For stations with beds which shift slowly or are materially changed only during floods rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in determining the flow at stations where the bed shifts but slowly.

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GENERAL DESCRIPTION OF THE GREAT BASIN.

In the interior of the North American continent, west of the Rocky Mountains, is an immense area known as the Great Basin, the streams of which do not discharge to the ocean. The area is not one single drainage basin, but consists rather of a number of basins, some of which are connected and others closed; the outer rim of all, however, is at such an elevation that the region as a whole has no surface outlet.

In outline the Great Basin is rudely triangular. Its western border is the Sierra Nevada, its northern the Columbia plateaus, its eastern the Rocky Mountains and the Colorado plateaus, while its southern extremity extends almost to the Gulf of California. This inclosed area is approximately 800 miles long from north to south, 500 miles broad at its widest part, and has been estimated to include 208,000 square miles. It comprises the western part of Utah, almost all of Nevada, and contiguous parts of Idaho, Oregon, and California.

Topographically this interior drainage area is characterized by isolated, narrow mountain ranges, trending north and south, which are separated by broad valleys varying considerably in altitude. In the southern part the valleys are low, Death Valley being below sea level, while in the north the valleys have a general elevation of from 4,000 to 5,000 feet. The intervening highlands often rise several thousand feet above their bases, and some of the peaks of the bordering ranges attain elevations of 13,000 feet above sea level.

Upper branches of the intermontane valleys extend into the interior ranges as narrow drainage ways that are dry during most of the year; but the drainage from the high mountains on the east and west borders of the basin passes through deep canyons into the broad valleys, where the perennial streams maintain lakes. Among these are Great Salt, Utah, and Sevier lakes in the eastern part, and Pyramid, Winnemucca, Honey, Walker, Mono, and Owens lakes in the western part of the Great Basin. With the exception of Utah Lake, which discharges by Jordan River into Great Salt Lake, these lakes are saline in character, as a consequence of the concentration of salts due to evaporation. Bear Lake, in the mountains of the eastern border, and Lake Tahoe, in the Sierras, are large bodies of fresh water that drain, respectively, to Great Salt and Pyramid lakes. Shallow, temporary bodies of water accumulate in some of the broad intermontane valleys during the wet season, but completely evaporate during the summer, leaving muddy plains called playas.

Geologically the Great Basin is well known as the type region of the "Basin Range structure." Many of the isolated, narrow mountain ranges that trend north and south are steep on one side, exposing cross sections of the rocks, and sloping on the other, conforming with the dip of the strata. These ranges have been uplifted by movements of the earth's crust which have broken it into tilted blocks. The greatest displacements of the Great Basin are associated with the eastern and western borders, the Wasatch Mountains and the Sierra Nevada having been uplifted many thousand feet. The mountains of the Great Basin are commonly composed of Paleozoic strata, often modified by volcanism, and the products of weathering and disintegration of these rocks have accumulated in the broad intervening valleys, which are strewn to great depths with unconsolidated débris.

The climate of the Great Basin is extremely arid, and except a few favored spots where irrigation is practiced, the region in general is a desert. Over the larger part of the area the annual precipitation is less than 10 inches, but it is greater on the bordering high lands, especially on the Sierra Nevada, where it is over 40 inches. Temperature varies widely, owing to the large extent of the area and to differences in elevation. Over most of the region the heat of the summer days is intense, but the diurnal variation is considerable. Evaporation is enormous. From the surface of water in the vicinity of Salt Lake City it amounts to about 60 inches in a year, and over the major part of the Great Basin it is much greater, amounting in places possibly to 150 inches.

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An arid climate, however, has not always prevailed in this region. In late geologic time (early Quaternary) the bordering high mountains supported glaciers, and enormous lakes, the old shore lines of which are now plainly marked on the sides of many valleys, accumulated in the Great Basin. The two largest of these lakes have been named after early explorers. Lake Bonneville occupied a considerable part of western Utah, its shrunken remnants being represented by Sevier, Utah, and Great Salt lakes; and Lake Lahontan covered an immense area in western Nevada.

The chief rivers of the Great Basin rise in the mountains which form its eastern and western borders and receive their principal supply from melting snow. The nature of the stream discharge is characteristic; the maximum commonly occurs in late spring or early summer, after which the flow decreases, reaching a minimum during the winter months. After leaving the mountains the streams receive little or no increment; in the broad, waste-filled valleys evaporation and seepage cause diminution in size, and often they entirely cease to flow.

For convenience of treatment, the drainage of the Great Basin has been divided into four areas, viz, Wasatch Mountains, Humboldt Sink, Sierra Nevada, and Great Basin drainage in Oregon. The data collected in these areas during 1906 are given in the following pages.

WASATCH MOUNTAINS DRAINAGE.

PRINCIPAL STREAMS.

The Wasatch Mountains drainage area includes the western half of Utah and small portions of Idaho and Wyoming. The headwaters of the various streams lie either in the Wasatch Mountains or in the plateaus to the south, and they drain either into Great Salt Lake or Sevier Lake. The following are the principal rivers of the area:

Bear and Weber rivers, discharging into Great Salt Lake.

City, Parleys, Emigration, Mill, and Big and Little Cottonwood creeks, tributary to Jordan River and thus to Great Salt Lake. These creeks have small watersheds, but in the mountain courses maintain perennial flows. On reaching the main valley they are extensively used for irrigation and the first three furnish the chief water supply for Salt Lake City.

American Fork, Hobble Creek, Spanish Fork, and Provo River, discharging into Utah Lake.

Sevier River, with its tributary, San Pitch River, draining into Sevier Lake.

BEAR RIVER BASIN.

DESCRIPTION OF BASIN.

Bear River rises on the northern slope of the Uinta Mountains, in the northeastern part of Utah, and after a circuitous course—in which it leaves Utah and enters Wyoming, reenters Utah, appears again in Wyoming, and makes a long detour in Idaho—it returns again to Utah and finally discharges its waters into Great Salt Lake. The maximum elevation of the upper rim of the basin is 13,000 feet.

In the upper part of its course, above the Dingle gaging station, the country is rough and broken, the rocks of the extreme headwater regions being principally sandstone and quartzite, covered with a thin layer of soil which supports scattered groves of fir and aspen. Farther down the prevailing formation is a compact limestone covered with a clayey soil, generally dry and with a rank growth of sagebrush. The tributary streams are numerous and well distributed, but they are generally short and confined to steep, narrow canyons. There are no marshes, extensive meadows, or forests, but a few small lakes lie near the head of the river. Numerous small springs and the melting snow which comprises the greater part of the precipitation are the chief sources of supply. The annual high-water period occurs during May and June, and the stream is not subject to quick floods or freshets.

Just below Dingle the main stream passes through the north end of Bear Lake Valley in a well-defined channel with no overflow, and from this point to Preston it is confined largely to a steep, narrow canyon, with occasional small, narrow valleys containing irrigated farms. The tributaries in this portion of the basin are few, the principal ones being Mink and Cottonwood creeks. About 10 miles below Dingle the outlet to Bear Lake joins the river. This is a small, crooked, sluggish stream, that discharges but little water at any time, though it is the only visible outlet to Bear Lake, which has an area of about 144 square miles.

The total unappropriated flow between Dingle and Preston is used for irrigation. There is no storage on the main stream, but on Mink Creek a number of small storage reservoirs are contemplated or in process of construction, the water to be diverted for the irrigation of lands in the northwest end of Cache Valley.

Between Preston and Collinston the Bear is a sluggish stream, traversing the west side of Cache Valley in a well-defined channel, which during extreme floods overflows slightly and covers a very narrow strip immediately along the river. The principal tributary streams in this portion of the course are Cub Creek and Logan River. The former has its source in the Bear River Range, and drains a rough country of limestone with but little overlying soil. The creek is confined to a steep, narrow canyon until it reaches Cache Valley, where it flows sluggishly for about 15 miles through a winding, but well-defined, channel into Bear River. It discharges considerable water into the main stream during flood and winter seasons, but its entire summer flow is used for irrigation in the north end of Cache

Valley. A gaging station was maintained during a part of 1900 and 1901 on Cub Creek about 4 miles northeast of Franklin, at the mouth of the canyon, but, owing to unfavorable conditions, it was discontinued.

Logan River enters the Bear about 7 miles above the gaging station at Collinston, a short distance above the point where it leaves Cache Valley and enters the canyon.

Practically the only inflow to the Bear in Cache Valley is from seepage and springs. The lower portions of the valley form an artesian basin containing numerous small, flowing wells. The water table lies very near the surface, and during the early spring the lower lands are largely swamp.

The Bear River Canal Company diverts the entire summer flow of the stream above Collinston onto agricultural lands lying on both sides of the river below Bear River Canyon. This system has a capacity of about 1,000 second-feet, and during the winter and flood seasons a part of the water is used to develop electric power at a point about one-fourth mile above the Collinston station, being returned to the river at Collinston. From 10 to 30 second-feet reach the stream through leaks and as seepage from the diversion canals.

Owing to the complete control of the stream by irrigation works, the discharge is liable to extreme variation at any period.

BEAR LAKE AT FISHHAVEN, IDAHO.

This station was established October 5, 1903. It is located at Fishhaven, Idaho, on the west shore of Bear Lake, about 4 miles north of the Idaho-Utah State line. It is on land used as a summer resort, owned by G. C. Gray, of Montpelier, Idaho, and is immediately south of the summer resort known as Nelsons Camp. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 19.

Daily gage height, in feet, of Bear Lake at Fishhaven, Idaho, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1							17	1.9					
2						3.4	18						
3							19					3.3	
4							20						
5		1.9			3.0		21				2.8		
6							22						
7	1.85			2.4			23		2.0				3.5
8			2.05				24	1.9					
9						3.5	25						
10							26					3.4	
11							27						
12					3.2		28		2.0		2.8		
13							29						
14		1.95		2.6			30						3.5
15							31						
16						3.55							

BEAR RIVER AT DINGLE, IDAHO.

This station was established May 9, 1903. It is located in a cut made by the Oregon Short Line Railroad Company one-fourth mile east of the Dingle railroad station and about 250 feet south of the track. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 20, where are given also references to publications that contain data for previous years.

Discharge measurements of Bear River at Dingle, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 25[a]	W. G. Swendsen	88	159	4.61	212
May 30	H. S. Kleinschmidt	122	609	7.40	2,690
August 17	Thos. Grieve, jr.	107	188	3.90	276

[a] Ice 1.2 feet thick at the gage.

Daily gage height, in feet, of Bear River at Dingle, Idaho, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.5		5.5	5.0	7.55	5.45	4.3	4.4	4.0	4.0	4.2
2				5.2	5.0	7.55	5.45	4.3	4.4	4.0	4.0	4.2
3	3.7			5.2	4.9	7.6	5.4	4.25	4.4	3.95	4.0	4.1
4		3.4	4.4	5.2	4.9	7.6	5.3	4.2	4.4	3.95	4.0	4.0
5				5.2	5.0	7.45	5.3	4.2	4.5	3.95	3.95	4.0
6	3.1			5.0	5.2	7.2	5.4	4.2	4.55	3.95	4.0	4.0
7		3.1		5.2	5.2	7.0	5.4	4.2	4.55	3.95	4.0	4.0
8			4.4	5.3	5.2	7.0	5.1	4.2	4.5	3.9	4.0	4.0
9				5.0	5.2	6.95	5.1	4.2	4.4	3.9	4.0	4.0
10	3.3	3.4		5.0	5.3	6.9	5.2		4.4	3.9	4.0	4.0
11				5.0	5.4	6.95	5.1	4.1		3.9	4.0	4.0
12			4.6	5.1	5.55	6.8	5.1	4.05	4.25	3.9	4.0	4.05
13				5.2	5.8	6.6	5.1	4.0	4.2	3.9	3.95	4.1
14	3.7	4.0		5.1	6.0	6.55	5.2	4.0	4.2	3.9	4.0	4.05
15				5.1	6.2	6.6	5.2	4.0	4.2	3.9	4.0	4.2
16			4.6	5.0	6.4	6.6	5.1	3.9	4.2	3.9	4.0	4.3
17	4.0			5.0	6.7		5.3		4.2	3.9	4.0	4.0
18				5.0	6.7	6.75	5.2	3.9	4.2	3.9	3.95	4.2
19		4.5	4.5	5.0	6.55	6.8	5.0	3.85	4.2	3.9	3.8	4.1
20	4.0			5.2	6.45	6.8	4.9	4.1	4.15	3.9		4.1
21				5.2	6.3	6.8	4.75	4.2	4.15	3.9	3.95	4.1
22		4.6	4.6	5.2	6.3	6.8	4.7	4.3	4.15	3.9	4.5	4.1
23	3.8			5.3	6.25	6.7	4.7	4.5	4.1	3.9	4.1	4.2
24				5.3	6.3	6.5	4.7	4.4	4.1	3.8		4.0
25		4.6	4.7	5.3	6.45	6.3	4.5	4.45	4.1	3.85	4.2	4.2
26				5.3	6.6	6.15	4.5	4.6	4.0	3.9	4.2	4.1
27				5.3	6.8	6.1	4.5	4.65		3.95	3.9	4.1
28	3.65	4.6	4.4	5.25	7.0	5.95	4.5	4.6	4.0	3.9	3.85	4.1
29				5.2	7.2	5.7	4.4	4.5	4.0	3.9	3.9	4.1
30			5.6	5.1	7.4	5.6	4.3	4.45	4.0	3.95	4.0	4.1
31			5.65		7.5		4.3	4.4		4.0		

NOTE.—Ice conditions January 1 to March 30 and November 22 to December 31. Ice thicknesses were recorded as follows:

Thickness of ice.

Date.	Thickness.	Date.	Thickness.
	Feet.		*Feet*
January 10, 17, and 20	0.8	February 25 and 28	1.2
January 23	1.0	March 4, 8, 12, 16, and 19	1.0
January 28	.9	March 22 and 25	.8
February 1	.8	March 28	.6
February 4	1.0	March 30	(a)
February 7	1.1	November 22	(a)
February 10 and 14	1.2	December 23	(b)
February 19 and 22	1.0		

a Ice gorged.

b Ice 0.5 foot thick.

Google

Rating table for Bear River at Dingle, Idaho, for 1904-1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	60	3.90	260	4.70	590	5.50	1,020	6.60	1,910
3.20	75	4.00	295	4.80	635	5.60	1,085	6.80	2,090
3.30	90	4.10	330	4.90	685	5.70	1,155	7.00	2,275
3.40	110	4.20	370	5.00	740	5.80	1,230	7.20	2,455
3.50	135	4.30	410	5.10	790	5.90	1,300	7.40	2,635
3.60	160	4.40	455	5.20	840	6.00	1,375	7.60	2,815
3.70	190	4.50	495	5.30	895	6.20	1,550	7.80	2,995
3.80	225	4.60	540	5.40	955	6.40	1,730	8.00	3,175

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 13 discharge measurements made during 1903-1906, and is well defined between gage heights 3.50 feet and 7.40 feet. Above gage height 6.10 feet the rating curve is a tangent, the difference being 90 per tenth.

Monthly discharge of Bear River at Dingle, Idaho, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	1,020	740	825	49,100
May	2,720	685	1,480	91,000
June	2,820	1,080	2,050	122,000
July	968	410	732	45,000
August	565	242	385	23,700
September	517	295	389	23,100
October	295	225	266	16,400
November 1-21	295	225	287	12,000
The period				382,000

BEAR RIVER NEAR PRESTON, IDAHO.

This station was established October 11, 1889. It is located about 6 miles from Preston, Idaho, 10 miles north of the Idaho-Utah boundary line and about 300 feet below the county road crossing at the old bridge of the Oregon Short Line Railroad. The data collected at this station are of extreme importance as showing the amount of water that passes from Idaho into Utah and will be of great value in the final adjudication of water rights on the stream. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 22, where are given also references to publications that contain data for previous years.

Discharge measurements of Bear River near Preston, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 24	W. G. Swendsen	184	320	1.27	584
April 12	H. S. Kleinschmidt	198	695	3.41	2,450
May 23	Thos. Grieve, jr.	201	772	3.79	3,110
July 28	do	191	397	1.54	687

Daily gage height, in feet, of Bear River near Preston, Idaho, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.40	1.25	2.70	3.20	4.45	2.78	1.38	1.85	1.30	1.30	1.30
2		1.35	1.20	2.70	3.12	4.40	2.68	1.30	1.85	1.05	1.55	1.55
3		1.35	1.20	2.55	2.95	4.40	2.58	1.28	1.85	1.04	1.55	1.36
4		1.30	1.20	2.50	3.00	4.42	2.52	1.22	1.80	1.04	1.55	1.07
5		1.40	1.20	2.58	3.00	4.48	2.50	1.20	1.80	1.04	1.55	1.07
6	2.90	1.35	1.22	2.62	2.95	4.70	2.42	1.15	1.75	1.04	1.55	1.07
7		1.52	1.22	2.90	2.90	4.68	3.32	1.10	1.75	1.04	1.55	1.07
8		1.68	1.25	3.35	2.90	4.58	2.22	1.10	1.75	1.24	1.55	1.07
9		1.40	1.30	3.42	2.90	4.50	2.30	1.05	1.75	1.45	1.55	1.07
10		1.20	1.30	3.60	2.90	4.48	2.28	1.00	1.75	1.45	1.55	1.07
11		1.12	1.30	3.60	2.90	4.38	2.22	1.00	1.75	1.24	1.55	1.07
12	3.00	1.05	1.30	3.40	2.90	4.25	2.18	1.00	1.70	1.04	1.55	1.07
13		1.05	1.30	3.40	3.28	4.12	2.10	.95	1.65	1.04	1.55	1.07
14		1.05	1.30	3.52	3.40	4.05	2.10	.90	1.68	1.04	1.55	1.07
15		1.05	1.30	3.65	3.82	4.00	2.10	.90	1.70	1.04	1.55	1.07
16		1.12	1.30	3.70	3.88	3.95	2.08	.85	1.60	1.04	1.55	1.07
17		1.20	1.35	3.82	3.80	3.85	2.00	.85	1.06	1.04	1.55	1.07
18		1.20	1.35	3.72	3.80	3.80	1.95	.85	1.06	1.04	1.07	1.07
19		1.38	1.60	3.70	3.80	3.72	1.88	.85	1.30	1.04	1.07	1.07
20	1.60	1.35	1.60	3.62	3.80	3.68	1.80	.85	1.55	1.04	1.07	1.07
21	1.60	1.35	1.40	3.60	3.80	3.52	1.75	.90	1.55	1.04	1.07	1.07
22	1.62	1.30	1.40	3.52	3.80	3.32	1.70	.95	1.30	1.04	1.07	1.07
23	1.35	1.25	1.55	3.50	3.80	3.30	1.65	1.02	1.05	1.04	1.07	1.07
24	1.30	1.25	1.90	3.50	3.85	3.30	1.60	1.05	1.05	1.04	1.07	1.07
25	1.25	1.25	2.25	3.45	4.00	3.32	1.60	1.06	1.05	1.04	1.07	1.07
26	1.30	1.25	2.15	3.42	4.20	3.28	1.60	1.68	1.05	1.04	1.07	1.75
27	1.35	1.25	1.90	3.40	4.42	3.18	1.60	1.72	1.05	1.04	1.07	1.08
28	1.40	1.25	1.92	3.32	4.52	3.08	1.58	1.78	1.05	1.04	1.05	1.75
29	1.30	......	1.95	3.20	4.50	2.98	1.52	1.85	1.55	1.04	1.05	1.41
30	1.28	......	1.98	3.20	4.60	2.88	1.48	1.85	1.55	1.04	1.05	1.36
31	1.40	......	2.20	......	4.52	......	1.40	1.85	......	1.04	......	1.65

NOTE.—River frozen January 1 to 19, February 7 to 10, and November 18 to 27. January 13 the ice was 1.15 feet thick, and the stream was nearly filled with needle ice.

Rating table for Bear River near Preston, Idaho, for 1905-6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	158	1.20	418	1.90	855	2.60	1,510	3.60	2,840
.60	186	1.30	468	2.00	935	2.70	1,630	3.80	3,150
.70	217	1.40	522	2.10	1,020	2.80	1,750	4.00	3,470
.80	251	1.50	580	2.20	1,110	2.90	1,870	4.20	3,800
.90	288	1.60	642	2.30	1,205	3.00	1,990	4.40	4,140
1.00	328	1.70	708	2.40	1,300	3.20	2,260	4.60	4,480
1.10	371	1.80	779	2.50	1,400	3.40	2,540		

NOTE.—The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1904-1906, and is well defined.

Monthly discharge of Bear River near Preston, Idaho, for 1906.

[Drainage area, 4,500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January 20-31	655	443	523	12,400	0.116	0.05
February	695	350	459	25,500	.102	.11
March	1,160	418	607	37,300	.135	.16
April	3,180	1,400	2,430	145,000	.540	.60
May	4,480	1,870	2,870	176,000	.638	.74
June	4,650	1,850	3,350	199,000	.744	.83
July	2,430	522	1,020	62,700	.227	.26
August	817	270	428	26,300	.095	.11
September	817	350	603	35,900	.134	.15
October	551	345	368	22,600	.082	.09
November	611	350	496	29,500	.110	.12
December	744	358	420	25,800	.093	.11
The period	4,650	270	1,180	798,000	.262	3.33

NOTE.—The open-channel rating was applied to the frozen periods without correction, and the above values are liable to further error during the winter period owing to uncertainty regarding the ice conditions.

BEAR RIVER NEAR COLLINSTON, UTAH.

This station was established July 1, 1889. It is located 6 miles from Collinston station on the Oregon Short Line Railroad, about one-fourth mile below the electric-power plant in Bear River Canyon, and is at the lower end of the canyon separating Cache and Great Salt Lake valleys, at a point below all diversion from the stream. It shows the amount of unappropriated water that is discharged as waste into Great Salt Lake. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 25, where are given also references to publications that contain data for previous years.

Discharge measurements of Bear River near Collinston, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 22	W. G. Swendsen	272	598	2.05	1,490
May 23	Thos. Grieve, jr.	288	1,120	4.30	4,420
June 20	do	290	1,180	4.35	4,600
July 26	do	268	305	1.25	621

Daily gage height, in feet, of Bear River near Collinston, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.35	1.4	1.85	3.05	3.8	5.75	3.15		2.1			1.9
2		1.45	1.75	3.4	3.75	5.85	3.0					
3	1.4	1.45	1.7	3.5	3.5	5.55	2.85				1.85	
4	1.4	1.45	1.6	3.25	3.8	5.45	2.7					
5	1.4	1.45	1.65	3.05	3.55	5.5	2.55					
6		1.5	1.65	3.1	3.6	5.5	2.45			1.65		
7	1.3	1.4	1.7	3.2	3.65	5.5	2.3					
8	1.2	1.35	1.7	3.25	3.55	5.55	2.1		1.95			2.1
9	1.2	1.35	1.75	3.55	3.55	5.6	1.95					
10	1.15	1.4	1.8	3.85	3.55	5.45	1.85				1.9	
11	1.2	1.4	1.95	3.85	3.6	5.3	2.1					
12	1.25	1.45	1.95	4.05	3.6	5.1	1.95					
13	1.25	1.45	2.55	3.95	3.7	4.95	1.9			1.65		
14	1.3	1.5	2.7	3.85	3.95	4.9	1.8					
15	1.35	1.6	2.3	3.85	4.1	4.85	1.75		2.25			2.05
16		1.8		3.9	4.3	4.75	1.7					
17	1.3	2.0	1.85	4.0	4.5	4.75	1.65				1.95	
18			1.8	4.15	4.5	4.7	1.55					
19	1.2		1.8	4.25	4.45	4.5	1.55					
20	1.15		1.8	4.25	4.35	4.35	1.55			1.7		
21	1.15	2.15	1.8	4.2	4.25	4.15	1.5					
22	1.8	2.1	1.85	4.15	4.25	3.95			1.8			2.0
23	1.65	2.0	2.1	4.1	4.2	3.85		2.3				
24	1.6	1.95	2.45	4.2	4.2	3.65					1.75	
25	1.55	1.95	3.3	4.25	4.25	3.5		2.2				
26	1.6	1.9	3.8	4.3	4.35	3.45	1.25					
27	1.75	1.8	3.55	4.25	4.4	3.35				1.8		
28	1.5	1.8	3.3	4.05	4.7	3.3						
29	1.45		3.05	3.75	4.95	3.25			1.65			2.25
30	1.4		2.9	3.55	5.25	3.15						
31	1.4		2.9		5.55							

NOTE.—Bear River seldom freezes over at this station, the only ice conditions being a narrow strip of ice along each bank during December and January.

Rating table for Bear River near Collinston, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	550	1.90	1,315	2.70	2,190	3.50	3,250	4.60	4,960
1.20	620	2.00	1,420	2.80	2,300	3.60	3,390	4.80	5,300
1.30	705	2.10	1,530	2.90	2,420	3.70	3,530	5.00	5,640
1.40	805	2.20	1,640	3.00	2,550	3.80	3,670	5.20	5,980
1.50	905	2.30	1,750	3.10	2,690	3.90	3,820	5.40	6,320
1.60	1,005	2.40	1,860	3.20	2,830	4.00	3,980	5.60	6,660
1.70	1,105	2.50	1,970	3.30	2,970	4.20	4,300	5.80	7,000
1.80	1,210	2.60	2,080	3.40	3,110	4.40	4,620		

NOTE.—The above table is applicable only for open-channel conditions. It is based upon discharge measurements made during 1904-1906, and is well defined.

Monthly discharge of Bear River near Collinston, Utah, for 1906.

[Drainage area, 6,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,210	585	783	48,100	0.130	0.15
February	1,580	755	1,100	61,100	.183	.19
March	3,670	1,000	1,700	105,000	.283	.33
April	4,460	2,620	3,700	220,000	.617	.69
May	6,580	3,250	4,210	259,000	.702	.81
June	7,080	2,760	5,090	303,000	.848	.95
July 1-21	2,760	905	1,530	63,700	.255	.20
The period				1,060,000		

NOTE.—Values for January and February may be slightly affected by ice.

LOGAN RIVER NEAR LOGAN, UTAH.

Logan River rises on the west slope of Bear River Range, flows southwest, then northwest, and unites with Bear River near Benson, Utah. The entire basin is rough and rugged, the elevations ranging from 4,500 to 9,000 feet, and the stream being confined largely to a steep and rough channel in a comparatively narrow canyon. Probably three-fourths of the precipitation in the basin is snow, the melting of which forms the chief source of supply for the spring and early summer flow. The late summer and winter flow is derived chiefly from springs, which are well distributed over the basin. In its upper course the stream has numerous small tributaries, all short and swift. Temple Fork and South Fork, which enter the river about 10 and 15 miles, respectively, above the gaging station, are perennial streams and furnish from one-third to one-fourth of the total flow. Blacksmith Fork comes in below the gaging station. There is no storage on the stream at present. The entire flow, after being utilized to furnish power at two electric plants near the mouth of the canyon, is used for irrigation.

A gaging station was established June 1, 1896, about 2 miles east of the city of Logan, near the mouth of the canyon. It was discontinued July 18, 1903, and reestablished April 13, 1904, at a point along the canyon road about 50 feet below the highway bridge, at the mouth of the canyon, 800 feet below the Hercules power house and about 1,000 feet above the old gaging station. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 28, where are given also references to publications that contain data for previous years.

About May 1, 1906, this station was moved by the Telluride Power Company to a point about 400 feet downstream. The gage is a 4 by 6 inch timber graduated to feet and tenths. It is set in an inclined position and is directly under the cable.

The description of the channel conditions, etc., is practically the same as given for the old station.

Discharge measurements of Logan River, near Logan, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 23	W. G. Swendsen	39	46.5	1.83	102
April 11	H. S. Kleinschmidt	67	68.0	2.24	244
May 5	do	46	95.0	2.80	587
May 23	Thos. Grieve, jr	60	130	3.27	779
June 21	do	63	130	3.30	779
July 27	do	48	77.4	2.53	268

Daily gage height, in feet, of Logan River near Logan, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	1.83	1.82	2.05	2.45	3.45	3.10	2.43	2.33	2.19	2.10	2.15
2	1.75	1.85	1.83	2.02	2.48	3.40	3.10	2.40	2.33	2.20	2.08	2.10
3	1.85	1.84	1.80	1.97	2.60	3.40	3.10	2.40	2.33	2.30	2.10	2.15
4	1.85	1.75	1.85	1.93	2.70	3.42	3.08	2.40	2.32	2.22	2.05	2.25
5	1.85	1.82	1.70	1.85	2.78	3.42	3.02	2.38	2.31	2.20	2.08	2.20
6	1.83	1.75	1.74	2.04	2.80	3.50	3.00	2.88	2.30	2.15	2.20	2.15
7	1.83	1.72	1.75	2.09	2.78	3.42	2.90	2.35	2.30	2.15	2.10	2.15
8	1.83	1.78	1.78	2.15	2.85	3.40	2.80	2.35	2.30	2.20	2.00	2.15
9	1.86	1.84	1.78	2.20	2.98	3.38	2.85	2.32	2.29	2.20	2.00	2.15
10	1.89	1.84	1.79	2.20	3.02	3.35	2.90	2.32	2.28	2.20	2.10	2.15
11	1.85	1.66	1.80	2.22	3.10	3.40	2.83	2.32	2.25	2.15	2.00	2.15
12	1.90	1.82	1.80	2.20	3.18	3.52	2.80	2.32	2.25	2.15	2.00	2.15
13	1.83	1.84	1.90	2.20	3.08	3.55	2.80	2.32	2.25	2.13	2.10	2.15
14	1.85	1.85	1.80	2.21	3.08	3.57	2.75	2.48	2.25	2.13	2.30	2.15
15	1.70	1.85	1.85	2.20	3.10	3.60	2.70	2.30	2.28	2.10	2.30	2.10
16	1.83	1.86	1.73	2.23	3.00	3.60	2.70	2.28	2.23	2.00	2.00	2.10
17	1.86	1.85	1.73	2.32	2.90	3.55	2.70	2.28	2.23	2.05	2.10	2.10
18	1.88	1.85	1.77	2.45	2.85	3.50	2.65	2.25	2.23	2.05	1.90	2.10
19	1.93	1.86	1.79	2.42	2.87	3.45	2.60	2.28	2.21	2.20	1.90	2.15
20	2.08	1.77	1.79	2.45	3.00	3.42	2.60	2.30	2.20	2.00	2.00	2.20
21	1.70	1.78	1.80	2.45	3.03	3.40	2.58	2.55	2.20	2.00	2.00	2.15
22	1.73	1.79	1.80	2.52	3.10	3.40	2.55	2.60	2.30	2.10	2.10	2.15
23	1.90	1.83	1.81	2.47	3.13	3.38	2.55	2.45	2.30	2.20	2.05	2.10
24	1.85	1.74	1.81	2.48	3.40	3.35	2.52	2.43	2.22	2.50	2.10	2.10
25	1.83	1.85	1.93	2.55	3.41	3.20	2.52	2.39	2.21	2.20	2.20	2.10
26	1.83	1.80	1.93	2.47	3.40	3.18	2.50	2.38	2.21	2.20	2.20	2.20
27	1.83	1.84	1.93	2.40	3.60	3.20	2.50	2.38	2.21	2.20	2.20	2.15
28	1.85	1.81	1.90	2.38	3.80	3.22	2.48	2.37	2.19	2.20	2.20	2.20
29	1.80	....	1.93	2.37	3.70	3.15	2.45	2.35	2.18	2.15	2.20	2.15
30	1.79	....	2.00	2.42	3.55	3.13	2.45	2.34	2.20	2.20	2.15	2.15
31	1.80	....	2.00	....	3.50	....	2.45	2.33	....	2.10	....	....

NOTE.—Stream does not freeze at this point during winter months; 5 second-feet were flowing into the river from the canal November 14 to December 31.

Rating table for Logan River near Logan, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	30	2.10	194	2.60	410	3.10	672	3.60	964
1.70	60	2.20	232	2.70	460	3.20	728	3.70	1,026
1.80	92	2.30	274	2.80	510	3.30	786	3.80	1,088
1.90	124	2.40	318	2.90	562	3.40	844		
2.00	158	2.50	362	3.00	616	3.50	904		

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 6 discharge measurements made during 1906 and is fairly well defined.

Monthly discharge of Logan River near Logan, Utah, for 1906.

[Drainage area, 218 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	187	60	104	6,400	0.477	0.55
February	111	66	95	5,280	.436	.45
March	158	70	102	6,270	.468	.54
April	386	108	263	15,600	1.21	1.35
May	1,090	340	663	40,800	3.04	3.50
June	964	689	843	50,200	3.87	4.32
July	672	340	476	29,300	2.18	2.51
August	552	253	312	19,200	1.43	1.65
September	287	224	256	15,200	1.17	1.30
October	362	158	218	13,400	1.00	1.15
November	274	124	193	11,500	.885	.99
December	253	194	212	13,000	.972	1.12
The year	1,090	60	311	226,000	1.43	19.43

These discharges do not include the flow of Logan, Hyde Park, and Smithfield canal, which diverts water above the station.

BLACKSMITH FORK NEAR HYRUM, UTAH.

This stream rises on the western slope of the Bear River Range and flows southwest and then northwest into Logan River. The drainage basin of the tributary is in every way similar to that of the main stream. Only the flood and winter discharge, however, reaches the Logan, the entire spring and summer flow being used for irrigation on the tillable lands below the gaging station.

The gaging station was established July 19, 1900, near the tollgate in the mouth of the canyon near Hyrum, Utah, which is the nearest post-office. The station was discontinued December 31, 1902, and reestablished May 16, 1904, about 1,000 feet downstream from the tollgate and 800 feet above the Hyrum city electric-power plant. A station is also maintained at the power-plant race. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 31, where are given also references to publications contain data for previous years.

Discharge measurements of Blacksmith Fork near Hyrum, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 18	W. G. Swendsen	32.5	21.6	3.33	35
May 5	H. S. Kleinschmidt	40	54.7	4.08	184
May 23	Thos. Grieve, jr	40	51.3	3.90	150
June 21	do	39	46.6	3.85	116
July 22	do	38	37.4	3.59	72

Daily gage height, in feet, of Blacksmith Fork near Hyrum, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	3.3	3.4	3.5	3.9	4.4	3.7	3.6	3.6	3.5	3.4	3.3
2	3.3	3.3	3.4	3.4	3.9	4.4	3.7	3.6	3.6	3.5	3.4	3.3
3	3.3	3.4	3.3	3.4	3.9	4.3	3.7	3.6	3.6	3.5	3.4	3.3
4	3.4	3.4	3.3	3.4	4.1	4.2	3.7	3.6	3.6	3.5	3.4	3.3
5	3.4	3.3	3.3	3.4	4.1	4.1	3.7	3.6	3.5	3.5	3.4	3.3
6	3.4	3.3	3.3	3.4	4.1	4.2	3.7	3.6	3.5	3.5	3.4	3.3
7	3.3	3.3	3.3	3.4	4.1	4.3	3.6	3.6	3.5	3.5	3.4	3.3
8	3.3	3.3	3.3	3.7	4.1	4.3	3.6	3.6	3.5	3.5	3.4	3.3
9	3.3	3.3	3.3	3.8	4.2	4.2	3.6	3.5	3.5	3.5	3.4	3.3
10	3.4	3.3	3.3	3.8	4.2	4.1	3.6	3.5	3.5	3.5	3.4	3.3
11	3.3	3.3	3.35	3.7	4.2	4.1	3.6	3.5	3.5	3.5	3.4	3.4
12	3.4	3.3	3.35	3.7	4.2	4.1	3.6	3.5	3.5	3.5	3.4	3.4
13	3.4	3.3	3.3	3.7	4.2	4.1	3.6	3.5	3.5	3.5	3.4	3.4
14	3.3	3.3	3.3	3.6	4.2	4.1	3.6	3.5	3.5	3.5	3.4	3.4
15	3.4	3.3	3.3	3.6	4.2	3.9	3.6	3.5	3.5	3.5	3.3	3.4
16	3.4	3.3	3.3	3.6	4.2	3.9	3.6	3.5	3.5	3.5	3.3	3.4
17	3.3	3.3	3.3	3.8	4.2	3.9	3.6	3.5	3.5	3.5	3.3	3.4
18	3.4	3.3	3.3	3.8	4.1	3.9	3.6	3.5	3.5	3.5	3.3	3.4
19	3.4	3.3	3.3	3.9	3.9	3.9	3.6	3.5	3.5	3.5	3.3	3.4
20	3.3	3.3	3.3	3.9	4.1	3.9	3.6	3.7	3.5	3.5	3.3	3.4
21	3.4	3.3	3.3	4.2	3.9	3.9	3.6	3.7	3.5	3.45	3.3	3.4
22	3.4	3.3	3.3	4.2	3.9	3.9	3.6	3.7	3.5	3.45	3.3	3.4
23	3.3	3.3	3.3	4.2	3.9	3.8	3.6	3.7	3.5	3.45	3.3	3.4
24	3.3	3.3	3.3	4.2	3.8	3.8	3.6	3.6	3.5	3.45	3.3	3.4
25	3.3	3.3	3.3	3.9	3.8	3.8	3.6	3.6	3.5	3.45	3.3	3.4
26	3.4	3.3	3.4	3.8	3.9	3.8	3.6	3.5	3.5	3.45	3.3	3.4
27	3.4	3.3	3.4	3.8	4.1	3.7	3.6	3.5	3.5	3.4	3.3	3.4
28	3.3	3.4	3.4	3.8	4.2	3.7	3.6	3.5	3.5	3.4	3.3	3.4
29	3.3	......	3.4	3.8	4.5	3.7	3.6	3.5	3.5	3.4	3.3	3.4
30	3.3	......	3.4	3.9	4.5	3.7	3.6	3.5	3.5	3.4	3.3	3.4
31	3.3	......	3.5	......	4.5	......	3.6	3.5	......	3.4	......	3.4

NOTE.—Ice does not form in sufficient quantities to interfere with the discharge.

Rating table for Blacksmith Fork near Hyrum, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	18	3.60	75	4.00	161	4.40	273	4.80	402
3.30	29	3.70	94	4.10	189	4.50	304	4.90	....
3.40	42	3.80	115	4.20	216	4.60	336	....	....
3.50	57	3.90	138	4.30	244	4.70	369	....	....

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1905-6 and is well defined.

Monthly discharge of Blacksmith Fork near Hyrum, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	42	29	34.9	2,150
February	42	29	30.4	1,690
March	57	29	33.3	2,050
April	216	42	108	6,430
May	304	115	191	11,700
June	273	94	167	9,940
July	94	75	78.7	4,840
August	94	57	67.6	4,160
September	75	57	59.4	3,530
October	57	42	53.2	3,270
November	42	29	35.0	2,080
December	42	29	37.8	2,320
The year	304	29	74.7	54,200

BLACKSMITH FORK POWER PLANT RACE, NEAR HYRUM, UTAH.

This station was established May 16, 1904, for the purpose of ascertaining the amount of water diverted around the regular gaging station at the tollgate and thus determining the total flow of the stream at that point. It is located about 600 feet down the canyon road from the tollgate at the mouth of the canyon, about 200 feet below the head of the canal or race, and about 500 feet south of the river station. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 33, where are given also references to publications that contain data for previous years.

Discharge measurements of Blacksmith Fork power plant race near Hyrum, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 18	W. G. Swendsen	12.5	25.8	4.72	76
May 5	H. S. Kleinschmidt	13.4	28.5	4.90	88
June 21	Thos. Grieve, jr	14.0	26.2	4.95	91

Daily gage height, in feet, of Blacksmith Fork power plant race near Hyrum, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.7	4.7	4.8	4.0	4.9	4.9	4.5	4.9	4.9	4.8	4.7	4.7
2	4.7	4.7	4.7	4.0	4.9	4.9	4.5	4.9	4.9	4.8	4.7	4.7
3	4.7	4.8	4.7	4.0	4.9	4.9	4.5	4.9	4.9	4.8	4.7	4.6
4	4.7	4.8	4.7	4.0	4.9	4.5	4.5	4.9	4.9	4.8	4.7	4.6
5	4.9	4.7	4.7	4.0	4.0	5.1	4.5	4.9	4.9	4.8	4.7	4.6
6	4.8	4.7	4.7	4.9	4.0	5.1	4.5	4.9	4.9	4.8	4.7	4.6
7	4.7	4.7	4.7	4.0	4.9	5.1	4.3	4.9	4.9	4.8	4.7	4.6
8	4.7	4.7	4.7	4.8	4.9	4.9	4.5	4.9	4.9	4.8	4.7	4.6
9	4.7	4.7	4.7	4.8	4.5	4.9	4.9	4.9	4.9	4.8	4.7	4.6
10	4.6	4.7	4.7	4.8	4.5	4.9	4.0	4.9	4.9	4.8	4.7	4.6
11	4.8	4.7	4.75	4.8	4.5	4.9	4.9	4.9	4.9	4.8	4.7	4.7
12	4.8	4.7	4.75	4.8	4.9	4.9	4.9	4.9	4.9	4.8	4.7	4.7
13	4.8	4.7	4.7	4.8	4.9	4.9	4.9	4.9	4.0	4.8	4.7	4.7
14	4.8	4.7	4.7	4.1	4.9	4.9	4.9	4.9	4.8	4.8	4.7	4.7
15	4.9	4.7	4.7	4.1	4.9	4.9	4.9	4.9	4.8	4.8	4.6	4.7
16	4.9	4.7	4.7	4.1	4.9	4.9	4.9	4.9	4.8	4.8	4.6	4.7
17	4.8	4.7	4.7	4.1	4.9	4.9	4.9	4.9	4.8	4.8	4.6	4.7
18	4.9	4.7	4.7	4.1	4.9	4.9	4.9	4.9	4.8	4.8	4.6	4.7
19	4.9	4.7	4.7	4.1	4.5	4.9	4.9	4.9	4.8	4.8	4.6	4.7
20	4.9	4.7	4.7	4.1	4.9	4.9	4.9	4.9	4.8	4.8	4.6	4.7
21	4.7	4.7	4.7	4.9	4.8	4.9	4.9	4.9	4.8	4.8	4.7	4.7
22	4.8	4.7	4.7	4.9	4.8	4.9	4.9	4.9	4.8	4.8	4.7	4.7
23	4.7	4.7	4.7	4.9	4.8	4.9	4.0	4.9	4.8	4.8	4.7	4.7
24	4.7	4.7	4.7	4.9	4.8	4.5	4.9	4.9	4.8	4.8	4.7	4.7
25	4.7	4.7	4.9	4.9	4.8	4.5	4.9	4.9	4.8	4.8	4.7	4.7
26	4.8	4.7	4.9	4.9	4.8	4.5	4.9	4.9	4.8	4.8	4.7	4.7
27	4.8	4.7	4.9	4.9	4.9	4.5	4.9	4.9	4.8	4.8	4.7	4.6
28	4.7	4.8	4.9	4.9	4.9	4.5	4.9	4.9	4.8	4.8	4.7	4.6
29	4.7	....	4.9	4.9	4.9	4.5	4.9	4.0	4.8	4.8	4.7	4.6
30	4.7	....	5.0	4.9	4.9	4.5	4.9	4.9	4.8	4.8	4.7	4.6
31	4.7	....	5.0	.....	4.9	.....	4.9	4.9	..	4.8	......	4.6

NOTE.—Little or no ice forms in the stream.

Rating table for Blacksmith Fork power-plant race near Hyrum, Utah, for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	25	4.30	44	4.60	66	4.90	88
4.10	31	4.40	51	4.70	73	5.00	96
4.20	37	4.50	58	4.80	80	5.10	104

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 11 discharge measurements made during 1904–1906 and is fairly well defined.

Monthly discharge of Blacksmith Fork power-plant race near Hyrum, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	88	66	77.7	4,780
February	80	73	73.8	4,100
March	96	73	77.3	4,750
April	88	25	60.5	3,600
May	88	58	82.6	5,080
June	104	58	81.6	4,860
July	88	58	80.3	4,940
August	88	88	88.0	5,410
September	88	80	83.5	4,970
October	80	80	80.0	4,920
November	73	66	71.6	4,260
December	73	66	70.1	4,310
The year	104	25	77.2	56,000

WEBER RIVER BASIN.

DESCRIPTION OF BASIN.

Weber River rises on the northern slope of the Uinta Mountains and flows in a tortuous course northwestward into Great Salt Lake.

The upper portion of the basin is very rough. The highest peaks, reaching an elevation of about 13,000 feet, are masses of sandstone and quartzite, entirely barren of vegetation and covered with snow for almost the entire year. Farther down the prevailing formation is limestone, overlain with sandstone and conglomerate. A thin layer of soil covers the basin in patches and supports small groves of fir and aspen. There are no extensive forests, meadows, or marshes. The greater part of the precipitation is in the form of snow, the melting of which is the chief source of the spring flood and early summer flow. A large part of the normal flow is derived from springs, which are well distributed over the area. Numerous tributaries, all short and confined to steep, narrow canyons, enter all along the course.

Between Oakley and Croyden the river traverses a very narrow valley comprising irrigated farms. The principal formation over this area is of conglomerate and sandstone, with but little loose and porous overlying soil except near the stream bed, where the deposit of bowlders and soil ranges from 10 to 20 feet in depth. The chief tributaries in this stretch of the river are Beaver Creek, which enters from the south about 6 miles below Oakley and drains a rough country about 71 square miles in extent; Chalk Creek, from the east, which drains a rough, dry country, about 248 square miles in area, and enters the Weber 15 miles above Croyden; and Lost Creek, which comes in from the east at a point about one-half mile above the Devils Slide gaging station and has a watershed of 205 square miles. Gaging stations are maintained near the mouth of Chalk and Lost creeks.

Between Croyden and Plain City the stream flows in a well-defined channel through a comparatively narrow, steep canyon, with occasional stretches of narrow valley containing irrigated farming lands. The rock is a porous and badly fissured sandstone and conglomerate, with but little overlying soil. Near the mouth of the canyon the material is a very rough but compact limestone. East Creek, which enters near Morgan, discharges but little water into the river, as its flow is completely controlled by a storage reservoir about 5 miles above its mouth, the water being used for irrigation in the Morgan Valley, through which the Weber flows. After leaving the Wasatch Range the Weber enters the Great Salt Lake Valley, through which it flows in a well-defined channel with no overflow.

Ogden River joins the Weber about 8 miles above Plain City. It drains a rough and rugged limestone area, 363 square miles in extent, in the western slopes of the Wasatch Range. The main stream and its numerous short tributaries are confined to steep, narrow canyons. The entire normal flow of the stream is diverted for irrigation near the foot of the canyon about 3 miles above the mouth of the river, after being used for the development of power by the Utah Light and Railway Company. The flood and winter flow, therefore, is all that reaches the Weber, except for a small amount of seepage from the irrigated district. The city of Ogden also derives its water supply from Ogden River.

There are at present no storage reservoirs on the Weber, but a number of possibilities exist.

WEBER RIVER NEAR OAKLEY, UTAH.

This station was established October 22, 1904. It is located approximately 200 feet south of the main canyon road, about 3 miles above Oakley, Utah, and is above all diversions to the Kamas prairie region. The object of the station is to determine the amount of water available for diversion through the low Kamas Pass into Provo River, which is a part of the reclamation scheme in the development of the Weber River project. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 36, where are given also references to publications that contain data for previous years.

Discharge measurements of Weber River near Oakley, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 9	W. G. Swendsen	48.5	38.6	5.10	[a]71.9
May 31	H. S. Kleinschmidt	51	146	5.95	768
August 11	Thos. Grieve, jr	46	74	4.50	127

[a] Ice 1.55 feet thick, gage height to top of ice 5.50 feet.

Daily gage height, in feet, of Weber River near Oakley, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	......	......	4.2	4.85	5.9	5.95	4.6	4.7	4.25	4.2	4.6
2	......	......	......	4.2	4.9	6.1	5.9	4.65	4.7	4.25	4.2	4.5
3	5.25	4.5	4.05	4.2	5.0	6.1	5.9	4.65	4.65	4.25	4.2	4.45
4	......	......	......	4.2	5.2	6.2	5.8	4.6	4.6	4.25	4.2	....
5	......	......	......	4.15	5.4	6.4	5.85	4.6	4.6	4.25	4.2	4.4
6	4.8	......	......	4.2	5.5	6.5	5.85	4.55	4.5	4.25	4.2	....
7	......	......	......	4.2	5.6	6.2	5.7	4.5	4.5	4.25	4.2	....
8	......	......	......	4.25	5.7	6.0	5.7	4.5	4.45	4.25	4.2	4.15
9	......	......	......	4.3	5.9	6.05	5.6	4.5	4.45	4.25	4.2	....
10	5.1	5.1	4.1	4.4	6.0	6.2	5.55	4.5	4.4	4.25	4.15	....
11	......	......	......	4.5	6.2	6.8	5.55	4.45	4.4	4.2	4.15	....
12	......	......	......	4.45	6.4	7.3	5.4	4.45	4.4	4.2	4.15	4.15
13	......	......	......	4.45	6.1	8.0	5.45	4.7	4.4	4.2	4.15	....
14	......	......	......	4.5	6.0	......	5.35	4.55	4.4	4.2	4.15	....
15	......	......	......	4.55	5.9	7.2	5.3	4.4	4.4	4.2	4.15	4.05
16	4.7	......	......	4.6	5.7	7.7	5.3	4.4	4.4	4.2	4.15	....
17	......	4.1	......	4.7	5.6	6.9	5.25	4.4	4.4	4.2	4.15	....
18	......	......	4.0	4.8	5.6	6.7	5.25	4.4	4.4	4.2	4.1	....
19	......	......	......	4.85	5.9	6.7	5.2	4.4	4.4	4.2	4.1	4.2
20	......	......	......	4.9	6.2	6.4	5.2	4.9	4.4	4.15	4.15	....
21	......	......	......	5.0	6.4	6.5	5.15	4.9	4.4	4.15	4.2	....
22	......	......	......	5.2	6.5	6.4	5.1	5.1	4.4	4.15	4.25	4.15
23	......	......	......	5.55	6.5	6.3	5.0	4.9	4.35	4.15	4.25	....
24	......	4.05	4.25	5.5	6.6	6.2	4.95	4.7	4.35	4.15	4.3	....
25	......	......	......	5.2	6.2	5.8	4.8	4.6	4.35	4.2	4.3	....
26	......	......	......	5.0	6.1	5.9	4.8	4.6	4.35	4.2	......	4.15
27	4.65	......	......	4.7	6.2	5.9	4.75	4.6	4.25	4.2	4.4	....
28	......	......	......	4.7	6.7	6.05	4.7	4.55	4.25	4.2	4.3	....
29	......	......	......	4.8	6.3	5.9	4.65	4.55	4.25	4.2	4.5	4.15
30	......	......	......	4.8	6.2	5.85	4.6	4.4	4.25	4.2	4.6	....
31	......	......	4.2	......	6.0	......	4.6	4.4	......	4.2	......	....

NOTE.—Ice conditions, January 1 to March 30, with average ice thickness of about 1.0 foot; November 19 to December 2, with a maximum thickness of 1.0 foot; and December 15 to 25. River free of ice December 3 to 14, and December 26 to 31.

Rating table for Weber River near Oakley, Utah, for 1905-6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	46	4.80	209	5.50	490	6.20	917	6.90	1,490
4.10	58	4.90	241	5.60	542	6.30	990	7.00	1,580
4.20	73	5.00	275	5.70	597	6.40	1,066	7.20	1,760
4.30	90	5.10	312	5.80	655	6.50	1,145	7.40	1,940
4.40	109	5.20	352	5.90	716	6.60	1,227	7.60	2,120
4.50	130	5.30	395	6.00	780	6.70	1,312	7.80	2,300
4.60	154	5.40	441	6.10	847	6.80	1,400	8.00	2,480
4.70	180								

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 10 discharge measurements made during 1904-6 and is well defined between gage heights 4.0 and 6.0 feet.

Monthly discharge of Weber River near Oakley, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	516	66	182	10,800
May	1,310	225	760	46,700
June	2,480	655	1,150	68,400
July	748	154	419	25,800
August	312	109	153	9,410
September	180	82	116	6,900
October	82	66	74.8	4,600
November 1-19	73	58	68.5	2,580
The period				175,000

WEBER RIVER NEAR CROYDEN, UTAH.

This station was established February 1, 1905. It is located about 1½ miles west of the town of Croyden, one-fourth mile below the junction of Lost Creek and Weber River, about three-fourths mile up the river from Croyden station on the Union Pacific Railroad, and 10 miles down the river from the town of Echo, just below the narrow canyon at the lower end of Henefer Valley.

The station is important as showing the amount of water available for storage in the Henefer basin, about 2 miles above the station, the development of which is a part of the reclamation scheme on the Weber River project. The winter records will be of special value, since the entire winter flow of the stream is at present discharged as waste into Great Salt Lake. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 38, where are given also references to publications that contain data for previous years.

Discharge measurements of Weber River near Croydon, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 8	W. G. Swendsen	91	87.1	1.75	154
April 29	H. S. Kleinschmidt	93	157	2.48	515
May 12	do	106	355	4.40	2,080
June 15	Thos. Grieve, jr	110	439	4.90	2,640
August 9	do	91	85.5	1.64	152

Daily gage height, in feet, of Weber River near Croydon, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.	1.6	1.8	1.9	3.2	2.87	4.22	3.0	1.72	2.15	1.8	1.82	1.74
2.	1.6	1.75	1.8	2.6	2.86	4.0	3.2	1.85	2.35	1.89	1.9	1.72
3.	1.65	1.7	1.8	2.5	2.89	4.1	3.3	1.83	2.4	1.8	1.87	1.8
4	1.7	1.8	1.85	2.2	3.15	4.1	3.1	1.82	2.2	1.68	1.86	1.85
5.	1.7	1.75	1.85	2.25	3.6	4.3	2.9	1.84	2.15	1.79	1.83	1.9
6.	1.6	1.7	1.8	2.35	3.64	5.0	2.8	1.81	2.1	1.8	1.85	1.91
7.	1.7	1.7	1.85	2.5	3.66	4.9	2.75	1.7	2.05	1.78	1.87	1.92
8.	1.7	1.6	1.85	2.98	3.68	4.35	2.7	1.71	2.0	1.79	1.9	1.9
9.	1.78	1.65	1.9	3.1	3.8	4.15	2.68	1.7	2.0	1.68	1.87	1.89
10.	1.6	1.65	1.95	2.85	3.9	4.3	2.65	1.67	2.0	1.75	1.86	1.9
11.	1.6	1.7	1.9	2.95	4.1	4.4	2.5	1.66	2.0	1.76	1.85	2.04
12.	1.6	1.75	1.9	2.9	4.1	4.8	2.45	1.65	2.0	1.75	1.82	2.2
13	1.6	1.75	2.2	2.65	4.09	5.3	2.4	1.67	1.95	1.75	1.83	2.02
14	1.65	1.8	2.1	2.6	4.1	5.4	2.4	1.65	2.0	1.76	1.82	1.9
15.	1.7	1.9	2.1	2.65	4.0	5.0	2.4	1.65	1.93	1.78	1.84	1.73
16.	1.7	2.0	1.9	2.7	3.8	4.45	2.35	1.67	2.0	1.77	1.84	1.7
17.	1.7	1.85	1.85	2.85	3.7	4.5	2.3	1.67	2.0	1.76	1.85	1.78
18.	1.75	1.85	1.85	3.1	3.55	4.45	2.2	1.67	2.0	1.75	1.8	1.8
19.	2.1	1.85	1.85	3.05	3.6	4.0	2.15	1.75	1.98	1.76	1.73	1.89
20.	2.0	1.8	1.8	3.05	3.9	3.9	2.1	2.0	1.9	1.77	1.74	1.9
21.	2.0	1.85	1.9	3.15	4.0	3.75	2.0	2.5	1.98	1.76	1.78	1.8
22.	1.9	1.8	2.0	3.35	4.2	3.7	1.95	2.65	1.98	1.75	1.9	1.75
23	1.8	1.8	2.2	3.5	4.15	3.68	1.9	2.67	1.89	1.73	1.74	1.85
24	1.8	1.8	2.45	3.55	4.1	3.5	1.9	2.4	1.87	1.73	1.79	1.87
25	1.85	1.85	3.1	3.35	4.3	3.0	1.89	2.3	1.89	1.8	1.8	1.88
26.	1.8	1.85	3.2	3.2	3.8	3.0	1.87	2.25	1.8	1.8	1.89	1.89
27.	1.8	1.8	3.0	3.15	4.4	3.1	1.85	2.2	1.8	1.79	1.85	2.1
28.	1.8	1.9	2.65	3.0	4.8	3.15	1.79	2.15	1.8	1.8	1.87	2.05
29.	1.8	......	2.62	2.9	5.2	3.5	1.68	2.1	1.79	1.78	1.86	2.0
30.	1.75	......	2.75	2.85	4.8	3.1	1.69	2.05	1.78	1.79	1.79	1.9
31.	1.8	......	2.6	......	4.55	......	1.7	2.1	......	1.78	......	1.89

NOTE.—Flow during the winter period was probably not greatly affected by ice conditions.

Rating tables for Weber River, near Croydon, Utah.

FEBRUARY 1, 1905, TO MARCH 31, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	50	1.80	160	2.20	319	2.60	541	3.00	820
1.50	73	1.90	195	2.30	368	2.70	605	3.10	900
1.60	99	2.00	233	2.40	422	2.80	673	3.20	985
1.70	128	2.10	274	2.50	480	2.90	745	3.30	1,070

APRIL 1, 1906, TO DECEMBER 31, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1.50	110	2.20	368	2.90	782	3.60	1,348	4.60	2,318
1.60	138	2.30	418	3.00	856	3.70	1,438	4.80	2,524
1.70	166	2.40	472	3.10	930	3.80	1,528	5.00	2,732
1.80	202	2.50	526	3.20	1,008	3.90	1,620	5.20	2,940
1.90	240	2.60	584	3.30	1,090	4.00	1,716	5.40	3,152
2.00	280	2.70	646	3.40	1,174	4.20	1,916		
2.10	322	2.80	712	3.50	1,260	4.40	2,116		

[a] This table is applicable only for open-channel conditions. It is based upon 8 discharge measurements made during 1905 and first quarter of 1906, and is well defined.

[b] This table is applicable only for open-channel conditions. It is based upon 4 discharge measurements made during 1906 and the form of the previous curve, and is well defined.

Monthly discharge of Weber River near Croydon, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	274	99	145	8,920
February	233	99	157	8,720
March	985	160	327	20,100
April	1,300	368	802	47,700
May	2,940	754	1,660	102,000
June	3,150	856	1,850	110,000
July	1,090	160	474	29,100
August	627	152	268	16,500
September	472	195	280	16,700
October	236	177	192	11,800
November	240	177	215	12,800
December	368	166	236	14,500
The year	3,150	99	550	399,000

WEBER RIVER NEAR PLAIN CITY, UTAH.

This station was established in 1903 under the direction of the State engineer of Utah, and was maintained under his direction until May 14, 1905, when it was taken up by the United States Geological Survey with the stipulation that the expense of daily gage readings should be defrayed by the State. It is located at the Plain City and West Weber highway bridge, about 10 miles west of Ogden, on the main road leading to Plain City and West Weber, below all points of diversion from and inflow to the stream.

The station is important as showing the amount of water discharged by the stream into Great Salt Lake, information necessary to the adjudication of water rights on the Ogden and Weber rivers. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, p. 41.

Discharge measurements of Weber River near Plain City, Utah, for 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 28	W. G. Swendsen	124	824	10.2	2,040
May 14	H. S. Kleinschmidt	139	1,280	13.8	3,510
June 1	do	131	1,640	16.3	4,630
June 14	Thos. Grieve, jr	133	1,460	14.9	4,090
June 27	do	115	432	6.9	729
July 16	do	93	151	4.0	139
August 11	do	36	14.8	2.6	10.5

Daily gage height, in feet, of Weber River near Plain City, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	5.0	5.0	10.2	10.1	10.3	7.8	2.8	5.3	4.3	5.1	5.5
2	......	5.0	5.4	9.8	9.9	10.8	7.5	2.7	5.7	4.2	5.2	5.5
3	4.6	4.9	5.3	9.0	9.8	16.0	7.3	2.7	6.0	4.1	5.2	5.5
4	......	4.9	5.3	8.0	10.3	15.6	6.8	2.7	5.5	4.1	5.2	5.5
5	......	4.8	5.4	8.2	12.7	15.2	0.4	2.7	5.2	4.1	5.2	5.5
6	4.2	4.7	5.5	8.2	12.2	15.0	5.9	2.6	5.1	4.1	5.2	5.5
7	......	4.7	5.4	8.3	12.4	16.0	5.6	2.6	4.9	4.2	5.1	5.5
8	......	4.8	5.3	9.2	12.4	15.8	5.3	2.6	4.8	4.2	5.1	5.5
9	......	4.9	5.3	9.9	12.8	15.5	5.2	2.6	4.7	4.3	5.1	5.6
10	4.3	5.0	5.5	10.6	13.0	14.7	5.1	2.6	4.5	4.3	5.1	5.6
11	......	4.9	5.7	10.2	13.2	14.0	4.9	2.6	4.4	4.3	5.1	5.4
12	......	4.8	6.3	9.8	13.8	14.2	4.8	2.6	4.4	4.3	5.0	5.3
13	4.9	4.8	7.4	9.1	14.4	14.4	4.5	2.0	4.3	4.3	5.0	5.2
14	......	4.9	6.8	9.1	13.6	14.7	4.2	2.6	4.3	4.2	5.0	5.1
15	......	5.1	6.3	9.2	12.5	14.6	4.0	2.6	4.4	4.2	5.0	5.0
16	......	5.3	6.1	9.8	12.2	13.8	3.9	2.6	4.5	4.3	5.0	5.0
17	5.2	5.3	5.8	10.9	11.4	13.1	3.5	2.6	4.6	4.3	5.1	5.1
18	......	5.3	5.8	11.8	10.6	12.5	3.3	2.6	4.6	4.4	5.1	5.2
19	......	5.3	5.8	12.1	10.8	10.9	3.1	2.6	4.6	4.5	5.2	5.2
20	7.4	5.4	5.9	11.6	11.0	10.4	3.0	3.2	4.6	4.6	5.2	5.2
21	......	5.5	6.0	11.9	11.6	9.7	2.9	6.7	4.6	4.7	5.3	5.3
22	......	5.5	6.0	12.4	11.8	9.3	2.9	8.5	4.6	4.7	5.3	5.3
23	......	5.4	7.3	13.1	11.6	8.9	2.9	8.0	4.6	4.8	5.3	5.3
24	5.3	5.3	7.5	13.4	11.4	8.5	2.9	7.3	4.6	4.8	5.3	5.3
25	......	5.3	10.7	12.5	11.3	8.3	2.8	6.2	4.6	4.8	5.3	5.3
26	......	5.3	11.5	11.9	12.0	8.1	2.8	6.1	4.5	4.9	5.3	5.9
27	5.1	5.4	11.1	10.7	12.7	8.0	2.8	5.9	4.5	4.9	5.4	7.5
28	......	5.4	10.3	10.2	14.7	8.3	2.9	5.9	4.4	5.0	5.4	6.9
29	......	......	9.3	10.0	16.0	8.1	2.9	5.8	4.4	5.0	5.4	6.1
30	......	......	9.2	10.0	16.0	7.8	2.8	5.7	4.3	5.0	5.5	5.7
31	5.4	......	9.4	......	17.3	......	2.8	5.5	......	5.1	......	5.6

NOTE.—Ice conditions January 1 to 30. Gage readings during the frozen period were taken to the surface of the water.

Rating table for Weber River near Plain City, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft*	*Feet.*	*Sec.-ft.*
2.60	10	3.50	70	4.40	185	5.60	395	7.40	905
2.70	14	3.60	80	4.50	200	5.80	440	7.60	975
2.80	18	3.70	90	4.60	215	6.00	490	7.80	1,045
2.90	23	3.80	102	4.70	230	6.20	540	8.00	1,115
3.00	28	3.90	114	4.80	245	6.40	595	9.00	1,500
3.10	34	4.00	128	4.90	260	6.60	655	10.00	1,895
3.20	40	4.10	142	5.00	275	6.80	715	11.00	2,310
3.30	50	4.20	156	5.20	315	7.00	775	12.00	2,740
3.40	60	4.30	170	5.40	355	7.20	835	13.00	3,180

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 7 discharge measurements made during 1906, and is well defined.

Monthly discharge of Weber River near Plain City, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
February	375	230	299	16,600
March	2,520	335	830	51,000
April	3,360	1,120	2,060	123,000
May	5,150	1,810	2,940	181,000
June	4,920	1,040	3,000	179,000
July	1,040	18	241	14,800
August	1,300	10	240	14,800
September	490	170	238	14,200
October	295	142	199	12,200
November	375	275	313	18,600
December	940	275	388	23,900
The period				649,000

PROVO RIVER BASIN.

DESCRIPTION OF BASIN.

Provo River has its source in the Uinta Mountains and flows westward in a steep, narrow canyon until it reaches Heber or Provo Valley, through which it winds in a well-defined channel. Leaving the valley, it flows southwestward, cutting through the Wasatch Range in another steep, narrow, and extremely rough canyon, and finally discharging its surplus waters into Utah Lake.

In the mountain regions the principal rock is a compact limestone. Except in Heber Valley there is but little soil in any portion of the basin. Small groves of fir and aspen are, however, scattered over almost the entire area, and there is a light growth of underbrush. There are no extensive forests, meadows, or marshes. In the canyons the stream receives numerous short and swift tributaries, deriving their principal supply from springs, but a part also from the melting of the snow, which covers portions of the high mountains during the entire year. The highest peaks reach elevations of about 13,000 feet.

Heber Valley, which comprises an area of about 20 square miles, is an irrigated farming district, composed of a deposit of loose bowlders, gravel, and soil, very porous. Most of the water comes from the main stream, though a part is received from small creeks which enter the valley from the south. The most important of these is Daniels Creek, into which some water is diverted from Strawberry River, a tributary of Green River, by three small canals in low passes at the head of the creek.

There are a few lakes at the head of the river, but they are so small that they probably have little effect in regulating the flow. There is no storage on the stream at present, but a few possibilities exist which will doubtless be developed in the future, as the entire stream, after being used at the mouth of the canyon for the development of power, is now utilized on lands in the vicinity of Utah Lake, and the supply is altogether insufficient.

PROVO RIVER ABOVE TELLURIDE POWER COMPANY'S DAM, NEAR PROVO, UTAH.

This station was established March 1, 1905. It is located about three-fourths of a mile up the river from Upper Falls, a station on the Provo Canyon branch of the Rio Grande Western Railway, about 4 miles above the mouth of the canyon and 800 feet south of the canyon road, in J. W. Slick's pasture. It is about one-half mile above the Telluride Power Company's dam and above all diversions into Utah Lake Valley. The object of the station is the collection of data concerning the amount of water passing from the river into this valley. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 50.

Discharge measurements of Provo River above Telluride Power Company's dam, near Provo, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 14	W. G. Swendsen	69	113	3.80	222
May 10	H. S. Kleinschmidt	76	222	5.30	886
June 3	Thos. Grieve, jr.	80	244	5.40	993
June 13	do	96	396	7.00	1,762
July 7	do	71	156	4.20	402

Daily gage height, in feet, of Provo River above Telluride Company's dam, near Provo, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug	Sept.	Oct.	Nov.	Dec.
1	3.8	3.8	4.0	4.65	4.5	6.2	4.45	3.85	4.0	3.9	4.1	3.8
2	4.0	3.8	3.9	4.4	4.5	5.7	4.45	3.9	4.05	3.9	4.05	3.8
3	4.1	3.7	3.9	4.55	4.5	5.35	4.45	3.9	4.05	3.8	4.05	3.8
4	3.8	3.7	3.95	4.1	4.6	5.4	4.45	3.95	4.05	3.8	4.0	4.1
5	3.85	3.7	3.85	4.1	4.8	5.4	4.4	3.9	4.05	3.8	4.0	4.15
6	3.9	3.65	3.8	4.1	5.0	5.5	4.4	3.85	4.0	3.9	4.05	4.0
7	3.9	3.5	3.85	4.15	4.1	6.4	4.35	3.8	4.0	3.9	4.0	4.0
8	4.25	3.7	3.85	4.25	4.9	5.7	4.3	3.8	4.0	3.9	4.0	4.0
9	4.25	3.6	3.9	4.35	5.0	5.3	4.15	3.8	4.0	3.9	3.95	4.0
10	5.0	3.7	3.95	4.5	5.3	5.5	4.1	3.8	3.95	3.9	3.95	4.05
11	4.0	3.85	4.0	4.5	5.4	5.35	3.95	3.75	3.95	3.9	3.95	4.1
12	3.75	3.75	4.8	4.5	6.2	6.3	3.9	3.75	3.95	3.9	3.9	4.15
13	3.8	3.75	4.5	4.35	6.3	6.7	3.9	3.75	3.95	3.9	3.9	4.3
14	.....	3.8	4.2	4.3	5.7	7.1	3.95	3.7	4.0	3.9	3.95	4.1
15	4.1	3.9	4.1	4.4	5.4	6.7	4.0	3.7	4.0	3.9	3.95	3.9
16	3.95	4.0	3.8	4.45	5.3	6.5	3.95	3.7	4.0	3.85	3.95	3.9
17	4.0	3.9	3.9	4.6	5.2	6.5	3.95	3.7	4.0	3.85	4.0	4.0
18	3.95	3.9	3.95	4.8	5.0	6.0	3.9	3.7	4.0	3.8	4.0	4.0
19	4.6	4.1	3.8	4.8	5.1	5.8	3.9	3.75	4.0	3.8	3.8	4.0
20	4.6	4.0	3.9	4.75	5.6	5.6	3.9	4.08	4.0	3.8	3.7	4.0
21	4.5	4.0	3.95	4.8	5.8	5.4	3.9	3.95	3.95	3.8	3.9	3.9
22	3.75	4.0	4.1	4.9	6.0	5.3	3.9	4.15	3.9	3.8	3.9	3.9
23	3.9	3.9	4.2	5.1	6.1	5.2	4.0	4.0	3.95	3.8	4.0	3.9
24	3.95	3.9	4.55	5.0	6.1	5.2	4.0	3.95	3.9	3.8	4.0	4.0
25	3.9	3.9	4.85	4.9	6.1	5.3	3.95	3.9	3.9	3.8	4.0	4.0
26	3.8	3.9	4.5	4.8	6.8	5.4	3.95	3.95	3.85	3.8	4.0	4.4
27	3.8	3.85	4.4	4.7	6.3	5.8	3.95	3.9	3.9	3.85	3.9	4.45
28	3.8	3.95	4.4	4.6	6.2	5.6	3.9	3.9	3.9	3.85	3.9	4.2
29	3.8	......	4.3	4.6	6.4	4.65	3.9	3.95	3.9	3.9	3.9	4.1
30	3.7	......	4.4	4.55	6.2	4.5	3.8	3.9	3.9	3.9	3.8	4.0
31	3.65	......	4.5	....	5.7	....	3.8	3.95	....	3.9	....	4.05

NOTE.—Ice conditions January 1-15. River assumed to be clear of ice after January 15.

Rating table for Provo River above Telluride Power Company's dam, near Provo, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.50	100	4.30	442	5.10	814	5.80	1,146	6.50	1,480
3.60	142	4.40	486	5.20	862	5.90	1,194	6.60	1,526
3.70	184	4.50	530	5.30	912	6.00	1,242	6.70	1,576
2.80	226	4.60	576	5.40	958	6.10	1,288	6.80	1,626
3.90	268	4.70	622	5.50	1,004	6.20	1,336	6.90	1,776
4.00	310	4.80	670	5.60	1,050	6.30	1,384	7.00	1,826
4.10	354	4.90	718	5.70	1,098	6.40	1,432	7.10	1,876
4.20	398	5.00	766						

NOTE.—The above table is applicable only for open-channel conditions. It is based upon 5 discharge measurements made during 1906 and is fairly well defined.

Monthly discharge of Provo River above Telluride Power Company's dam, near Provo, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January 16-31	576	163	303	9,620
February	354	100	238	13,200
March	694	226	370	22,800
April	814	354	556	33,100
May	1,630	354	999	61,400
June	1,880	530	1,110	66,000
July	508	226	337	20,700
August	376	184	251	15,400
September	332	247	297	17,700
October	268	226	249	15,300
November	354	184	290	17,300
December	508	226	327	20,100
The period				313,000

PROVO RIVER AT MOUTH OF CANYON, NEAR PROVO, UTAH.

This station was established July 27, 1889, and was discontinued June 30, 1906. It was located about 6 miles north of Provo, about 1,000 feet above Olmstead station, on the Provo Canyon branch of the Rio Grande Western Railway, and 1,200 feet above the power house of the Telluride Power Company. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 53, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Provo River at mouth of canyon, near Provo, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	3.35	3.00	4.05	4.90	4.95		17	3.91	3.95	4.05	4.92	5.52	6.15
2	3.80	3.68	3.90	4.70	4.80		18	4.05	3.90	4.05	5.15	5.40	5.95
3	3.62	3.60	3.85	4.55	4.82		19	5.15	4.12	3.95	5.12	5.50	5.92
4	3.71	3.52	3.88	4.45	5.00	5.80	20	4.90	4.08	4.10	5.10	5.92	5.90
5	3.66	3.55	3.82	4.28	5.18	6.02	21	4.38	4.20	4.02	5.25	6.10	5.75
6	3.61	3.56	3.85	4.28	5.32	6.50	22	4.00	4.08	4.25	5.40	6.20	5.68
7	3.31	3.55	3.80	4.35	5.32	6.12	23	3.92	3.95	4.60	5.40	6.25	5.55
8	3.60	3.55	3.95	4.42	5.40	5.80	24	4.04	3.88	4.95	5.40	6.30	5.50
9	3.46	3.54	4.02	4.65	5.42	5.68	25	3.95	4.00	5.28	5.30	6.32	5.25
10	3.65	3.70	4.15	4.85	5.65	5.90	26	3.91	3.92	5.50	5.20	6.08	5.05
11	3.65	3.55	4.05	4.90	5.82	6.15	27	3.91	3.90	4.90	5.00	6.42	5.10
12	3.70	3.61	5.15	4.82	6.25	6.50	28	3.75	3.98	4.82	4.95	6.58	5.18
13	3.78	3.50	4.68	4.70	6.50	7.02	29	3.55		4.70	4.95	6.60	5.10
14	4.00	3.70	4.40	4.55	5.90	6.78	30	3.62		4.65	4.90	6.18	5.08
15	3.99	3.95	4.22	4.60	5.72	6.45	31	3.69		4.45		5.92	
16	4.12	4.05	4.08	4.80	5.55	6.15							

NOTE.—Slight ice conditions during January.

HOBBLE CREEK BASIN.

HOBBLE CREEK, NEAR SPRINGVILLE, UTAH.

Hobble Creek rises on the western slope of the Wasatch Mountains and flows in a general southwesterly direction to Utah Lake. There is little overlying soil and but a scanty growth of timber or brush. The steep, narrow canyon in which the stream flows is broken here and there by narrow openings or flats, covered with a shallow deposit of bowlders and soil and comprising irrigated farms. As these tracts lie along the banks of the creek, a large part of the water used on them is returned to the stream as seepage. There are no tributaries of importance, but short, intermittent streams, each of which is confined to a steep, narrow canyon, enter all along the course. There are no storage reservoirs, lakes, or marshes to control the flood discharge, which occurs in the spring as the result of melting snow. The entire normal summer flow is used for irrigation, but the diversion takes place for the most part at the mouth of the canyon below the gaging station.

The station was established March 23, 1904. It is located about 1 mile above the mouth of the canyon, 4 miles southeast of Springville, Utah, 600 feet northeast of the head of Mapleton Canal, and about 1,200 feet southwest of the Springville electric power plant. The conditions and the bench marks are described in Water-Supply Paper No. 176, page 58, where are given also references to publications that contain data for previous years.

Discharge measurements of Hobble Creek near Springville, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 3	Thos. Grieve, jr	18.5	17.8	1.95	66.1
August 7	do	17.5	16.1	1.55	19.2

Daily gage height, in feet, of Hobble Creek near Springville, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.25		1.7	2.5	2.5	1.85	1.65	1.55	1.5	1.55	
2	1.25			1.7	2.5	2.45	1.85	1.6	1.6	1.5	1.55	
3		1.2		1.6	2.7	2.4	1.9	1.6	1.6	1.5	1.5	1.5
4				1.55	3.3	2.35	1.9	1.6	1.55	1.55		
5		1.2	1.35	1.55	3.8	2.35	1.85		1.55	1.55	1.5	1.5
6				1.6	4.0	2.45	1.85	1.55	1.55	1.55	1.45	
7	1.25	1.2	1.25	1.7	3.7		1.85	1.5	1.55	1.5	1.5	1.55
8				1.88	3.7	2.3	1.85	1.55	1.55	1.5		
9		1.2	1.25	2.1	3.8	2.25	1.85	1.55		1.45		
10	1.25		1.3	2.35	3.9	2.25	1.8	1.55	1.55	1.4		
11			1.3	2.5	3.9		1.8	1.55	1.55	1.45	1.5	1.55
12	1.25		1.35	2.35		2.2	1.75			1.45	1.5	
13		1.2		2.45	4.0	2.2	1.75	1.5	1.55	1.5	1.5	
14			1.35	2.4	3.4	2.2	1.75	1.55	1.55		1.5	
15				2.6	3.4	2.15	1.75	1.55	1.55	1.5	1.5	1.5
16	1.3			2.62	3.3	2,15	1.75	1.6		1.5		
17		1.3	1.3	3.35	3.2	2.15	1.75	1.55	1.6	1.5	1.5	
18		1.3		4.0	3.1	2.15	1.75	1.55	1.55	1.55		1.55
19	1.35	1.3	1.3	3.9	3.2	2.1	1.75		1.5	1.55	1.45	
20		1.25	1.3	3.6		2.0	1.75	1.7	1.5		1.45	
21	1.3		1.35	3.85	3.2		1.7	1.7	1.55		1.5	1.55
22			1.35		3.0	1.95	1.6	1.65	1.55	1.5		
23	1.3	1.3	1.35	3.9	3.0		1.6	1.6	1.55	1.5		
24		1.3	1.4	3.3	2.9		1.6	1.6	1.55	1.5	1.5	
25	1.25	1.3	1.45	3.0	2.7	1.9	1.55	1.55	1.55	1.5		1.55
26		1.25	1.55	2.7	2.7	1.85	1.65	1.55	1.55	1.5	1.5	
27	1.2	1.3	1.6	2.5	2.8	1.85	1.65	1.55	1.55	1.5		1.55
28			1.65	2.5	3.0	1.9	1.65	1.5	1.55			
29			1.6		2.8	1.8		1.55	1.55	1.5		1.55
30	1.25		1.6	2.45	2.6		1.6	1.57	1.4	1.5	1.5	
31			1.65		2.6		1.6	1.55		1.5		

SPANISH FORK BASIN.

DESCRIPTION OF BASIN.

Spanish Fork rises in the Wasatch Mountains and flows northwestward into Utah Lake. The area is generally barren, with but little timber or brush. The stream is confined to a steep, narrow canyon, with a very few small openings in which are irrigated farms. The tributaries are all short and many of them are intermittent. The most important are Diamond Fork and Thistle Creek, which enter about 8 and 10 miles, respectively, above the gaging station, and which, like the main stream, occupy steep narrow canyons. The normal flow comes largely from springs, scattered over the entire basin; the flood discharge is direct surface run-off from melting snow.

There are no storage reservoirs on the stream and but little of the flow is diverted above the gaging station at Spanish Fork; the entire normal flow is, however, diverted at the mouth of the canyon, immediately below the station, and used for irrigating lands near Utah Lake.

SPANISH FORK NEAR SPANISH FORK, UTAH.

This station was established May 23, 1900, and reestablished March 26, 1903. It is located 600 feet above the dam of the East Bench Irrigation Company, 5 miles southeast of Spanish Fork, and 300 feet southwest of the main line of the Rio Grande Western Railway.

Records at this station are of importance in connection with the Strawberry Valley storage reservoir project, under a plan to divert water from that basin into Spanish Fork near its head and carry it to distribution canals below. The conditions and the bench marks are described in Water-Supply Paper No. 176, page 60, where are given also references to publications that contain data for previous years.

Discharge measurements of Spanish Fork near Spanish Fork, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 20	W. G. Swendsen	34.5	23.4	1.49	75.8
February 4	do	35.5	27.3	1.48	69.6
March 3	do	34.5	25.5	1.40	57.5
March 22	do	36.1	32.5	1.55	109
April 28	H. S. Kleinschmidt	39.5	73.4	2.40	343
May 10	do	48.0	122	3.74	801
May 19	Thos. Grieve, jr	46.0	125	3.74	693
June 2	do	40.0	94.5	2.85	472
June 12	do	39.0	80.0	2.50	338
July 3	do	38.0	45.5	1.70	177
August 7	do	37.0	30.4	1.40	96
October 17	do	37.0	27.5	1.25	90

Daily gage height, in feet, of Spanish Fork near Spanish Fork, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.45	1.45	1.55	2.0	2.5	2.8	1.75	1.45	1.35	1.25	1.25	1.25
2	1.55	1.4	1.5	2.0	2.45	2.8	1.7	1.4	1.5	1.25	1.25	1.3
3	1.4	1.4	1.4	1.8	2.6	2.75	1.7	1.4	1.45	1.25	1.25	1.3
4	1.4	1.45	1.5	1.6	3.05	2.8	1.7	1.4	1.35	1.25	1.3	1.4
5	1.4	1.5	1.45	1.8	3.5	2.85	1.7	1.35	1.35	1.25	1.3	1.35
6	1.5	1.5	1.45	1.8	3.6	2.85	1.65	1.35	1.35	1.25	1.3	1.3
7	1.4	1.5	1.4	2.2	3.58	2.65	1.65	1.35	1.35	1.25	1.3	1.25
8	1.5	1.45	1.45	2.2	3.9	2.6	1.6	1.3	1.35	1.25	1.3	1.25
9	1.5	1.45	1.5	2.2	3.9	2.5	1.6	1.3	1.35	1.25	1.3	1.25
10	1.4	1.45	1.6	2.4	4.4	2.55	1.6	1.3	1.35	1.25	1.3	1.25
11	1.35	1.5	2.2	2.5	4.4	2.5	1.55	1.3	1.3	1.25	1.3	1.25
12	1.4	1.5	2.25	2.4	4.5	2.5	1.55	1.3	1.3	1.25	1.25	1.25
13	1.4	1.5	2.25	2.2	4.5	2.45	1.5	1.3	1.3	1.25	1.25	1.4
14	1.45	1.5	1.6	2.25	3.9	2.45	1.5	1.4	1.3	1.25	1.25	1.25
15	1.4	1.55	1.5	2.4	3.9	2.4	1.6	1.35	1.35	1.25	1.25	1.1
16	1.4	1.55	1.45	2.45	3.85	2.35	1.55	1.35	1.45	1.25	1.25	1.1
17	1.4	1.5	1.5	2.8	3.8	2.2	1.5	1.35	1.35	1.25	1.25	1.1
18	1.4	1.55	1.5	3.2	3.8	2.12	1.6	1.35	1.35	1.25	1.2	1.1
19	1.55	1.6	1.3	3.1	3.8	2.05	1.55	1.4	1.35	1.25	1.15	1.2
20	1.55	1.45	1.45	3.0	3.95	2.0	1.5	1.65	1.3	1.25	1.2	1.25
21	1.4	1.55	1.5	3.0	4.0	1.9	1.5	1.45	1.3	1.25	1.2	1.25
22	1.4	1.5	1.6	3.1	3.9	1.85	1.5	1.5	1.3	1.2	1.2	1.25
23	1.4	1.5	2.0	3.3	3.65	1.85	1.5	1.4	1.3	1.2	1.2	1.25
24	1.45	1.45	2.35	3.25	3.6	1.85	1.65	1.35	1.3	1.2	1.2	1.25
25	1.5	1.5	2.8	2.9	3.35	1.8	1.5	1.35	1.3	1.25	1.25	1.25
26	1.45	1.45	2.3	2.75	3.2	1.8	1.5	1.35	1.3	1.25	1.25	1.4
27	1.5	1.5	2.0	2.55	3.25	1.8	1.45	1.35	1.3	1.25	1.25	1.5
28	1.45	1.5	1.9	2.5	3.3	1.8	1.45	1.35	1.3	1.25	1.25	1.4
29	1.45	....	1.8	2.55	3.2	1.8	1.45	1.35	1.3	1.25	1.25	1.35
30	1.5	....	1.9	2.5	3.1	1.8	1.45	1.3	1.25	1.25	1.25	1.3
31	1.45	....	2.0	....	2.85	....	1.4	1.4	....	1.25	....	1.3

Google

Daily discharge, in second-feet, of Spanish Fork near Spanish Fork, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	68	68	89	233	368	456	169	112	96	81	81	81
2	89	57	78	233	354	454	158	104	120	81	81	88
3	57	57	57	177	393	426	158	104	112	81	81	88
4	57	68	80	122	515	439	158	104	96	81	88	104
5	57	78	70	177	637	452	158	96	96	81	88	96
6	78	78	74	177	665	452	148	96	96	81	88	88
7	57	78	74	288	658	398	148	96	96	81	88	81
8	78	68	75	288	743	385	138	88	96	81	88	81
9	78	68	85	288	742	358	138	88	96	81	88	81
10	57	68	110	344	874	372	138	88	96	81	88	81
11	48	78	278	372	874	358	129	88	88	81	88	81
12	57	78	292	344	907	358	129	88	88	81	81	81
13	57	78	294	288	905	344	120	88	88	81	81	104
14	68	78	116	302	743	344	120	104	88	81	81	81
15	57	89	93	344	741	331	138	96	96	81	81	62
16	57	89	80	357	747	318	129	96	112	81	81	62
17	57	78	94	455	724	277	120	96	96	81	81	62
18	57	89	95	567	722	257	138	96	96	81	74	62
19	89	100	53	538	720	240	129	104	96	81	68	74
20	89	68	84	510	750	227	120	148	88	81	74	81
21	57	89	96	510	765	203	120	112	88	81	74	81
22	57	78	123	538	740	192	120	120	88	74	74	81
23	57	78	233	504	672	192	120	104	88	74	74	81
24	68	68	328	580	660	192	148	96	88	74	74	81
25	78	78	455	483	593	180	120	96	88	81	81	81
26	68	68	316	442	555	180	120	96	88	81	81	104
27	78	78	233	385	570	180	112	96	88	81	81	120
28	68	78	215	372	585	180	112	96	88	81	81	104
29	68	......	177	382	560	180	112	96	88	81	81	96
30	78	......	215	368	533	180	112	88	81	81	81	88
31	68	......	233	......	467	......	104	104	......	81	......	88

NOTE.—Daily discharge obtained by indirect method for shifting channels March 3 to May 19 Two rating curves were used for the periods preceding and following March 3 and May 19, respectively.

Monthly discharge of Spanish Fork near Spanish Fork, Utah, for 1906.

[Drainage area, 670 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec-ft. per sq. mile.	Depth in inches.
January	89	48	66.4	4,080	0.099	0.11
February	100	57	76.0	4,220	.113	.12
March	455	53	158	9,720	.236	.27
April	504	122	369	22,000	.551	.61
May	907	354	661	40,600	.987	1.14
June	456	180	304	18,100	.454	.51
July	169	104	132.0	8,120	.197	.23
August	148	88	99.5	6,120	.149	.17
September	120	81	93.6	5,570	.139	.16
October	81	74	80.3	4,940	.120	14
November	88	68	81.0	4,820	.121	.14
December	120	62	84.7	5,210	.126	.15
The year	907	48	184.0	134,000	.274	3.75

SPANISH FORK NEAR LAKE SHORE, UTAH.

This station was established December 10, 1903, at the highway bridge on the road between Spanish Fork and Lake Shore, about 3 miles west of Spanish Fork. In May, 1904, it was reestablished at a point about 800 feet above the bridge.

As the entire normal summer flow is diverted at a point above, the station is maintained only during the spring and winter, the object being the determination of the amount of water discharged by Spanish Fork into Utah Lake.

The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 63, where are given also references to publications that contain data for previous years.

Discharge measurements of Spanish Fork near Lake Shore, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 20	W. G. Swendsen	27.0	26.5	4.53	72.2
February 3	do	27.0	25.6	4.48	65.3
March 2	do	30.0	31.3	4.50	83.1
March 23	do	37.5	60.9	5.41	181
April 28	H. S. Kleinschmidt	52.0	123	7.25	352
June 12	Thos. Grieve, jr	24.0	10.0	4.20	12.6

Daily gage height, in feet, of Spanish Fork near Lake Shore, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Nov.	Dec.
1		4.40	4.53	5.35	7.2	6.05	4.35	4.70
2	4.30	4.35	4.48	5.3	7.15	5.87	4.40	4.90
3		4.48	4.45	5.2	7.35	5.7	4.40	4.90
4		4.42	4.50	5.0	7.90	5.5	4.40	4.10
5	4.25	4.42	4.48	5.05	9.25	5.47	4.40	4.10
6		4.40	4.43	5.1	9.50	5.9	4.40	5.00
7		4.40	4.44	5.82	9.35	5.75	4.45	5.00
8		4.38	4.50	5.92	9.35	5.5	4.45	5.00
9		4.35	4.58	6.0	9.35	5.45	4.50	5.00
10		4.40	5.30	6.3	8.90	5.0	4.55	5.00
11		4.41	5.92	6.25	9.00	4.9	4.55	5.00
12	4.50	4.50	5.48	6.0	8.30	4.7	4.55	5.00
13		4.47	6.15	5.95	10.25	4.3	4.55	5.10
14	4.80	4.48	4.81	6.0	9.20	4.05	4.50	5.10
15	4.40	4.48	4.15	6.2	8.45	3.7	4.50	5.10
16	4.35	4.50	4.05	7.0	8.25		4.50	5.00
17	4.40	4.40	4.10	7.5	8.50	4.35	4.50	4.90
18	4.40	4.45	4.20	7.7	8.00	4.0	4.50	4.90
19	4.52	4.60	4.15	7.72	8.00		4.50	4.90
20	4.57	4.48	4.45	7.75	8.20		4.50	4.90
21	4.57	4.48	4.50	7.95	9.00		4.50	4.90
22	4.28	4.50	4.53	8.4	8.45		4.50	4.90
23	4.50	4.52	5.42	8.8	8.05		4.50	4.80
24	4.40	4.50	5.90	8.4	7.70		4.50	4.90
25	4.40	4.45	6.90	8.6	7.35		4.50	4.90
26	4.37	4.41	6.10	7.7	7.20		4.50	5.20
27	4.38	4.48	5.53	7.4	6.80		4.50	5.20
28	4.41	4.45	5.58	7.25	7.15		4.70	5.10
29	4.40		5.40	7.35	7.30		4.70	5.10
30	4.40		5.38	7.4	6.90		4.70	5.00
31	4.40		5.47		6.50			5.00

NOTE.—Flow probably slightly affected by ice conditions during winter months.

Daily discharge, in second-feet, of Spanish Fork near Lake Shore, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Nov.	Dec.
1	49	58	85	177	345	200	19	36
2	50	54	82	170	339	180	21	50
3	48	64	79	161	362	163	21	50
4	48	61	84	142	408	145	21	10
5	46	62	84	147	532	139	21	10
6	50	62	77	152	552	177	21	57
7	53	62	80	220	536	161	23	57
8	56	61	86	228	534	134	23	57
9	56	58	94	236	532	123	26	57
10	59	63	163	264	491	74	28	57
11	62	64	222	260	500	58	28	57
12	66	73	182	236	433	34	28	57
13	79	69	245	231	611	17	28	65
14	92	74	119	236	513	8	26	65
15	58	74	58	255	443	3	26	65
16	54	76	52	329	422	0	26	57
17	58	67	56	375	445	18	26	50
18	58	72	64	395	398	6	26	50
19	68	87	61	397	397	....	26	50
20	72	75	88	400	416	....	26	50
21	72	75	94	420	488	....	26	50
22	49	79	97	460	435	....	26	50
23	66	81	181	496	397	....	26	42
24	58	80	226	460	366	....	26	50
25	58	76	319	478	333	....	26	50
26	56	73	245	395	318	....	26	74
27	56	81	193	367	280	....	26	74
28	59	77	198	352	322	....	36	65
29	58	....	180	361	326	....	36	65
30	58	....	179	364	280	....	36	57
31	58	....	186	....	252	....	....	57

NOTE.—Total flow of river diverted for irrigation June 19 to October 31. Daily discharge obtained by indirect method for shifting channels. Open-channel rating applied during winter period which may give results which are somewhat too large.

Monthly discharge of Spanish Fork near Lake Shore, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	92	46	59.0	3,630
February	87	54	69.9	3,880
March	319	52	134	8,240
April	496	142	305	18,100
May	552	242	419	25,800
June	200	0	51.7	3,250
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	36	19	26.0	1,550
December	74	10	52.9	3,250
The year	552	0	93.4	67,700

SEVIER RIVER BASIN.

DESCRIPTION OF BASIN.

Sevier River rises in the northwestern part of Kane County, in southern Utah, flows northeastward to a point near Gunnison, northwestward nearly to Leamington, and then turns sharply to the southwest and discharges into Sevier Lake.

Tributary streams are few, San Pitch River and Salina Creek being the most important. The San Pitch joins the main stream about 3 miles above the gaging station, but since its flow is used for irrigation and is completely controlled by storage reservoirs, it furnishes little of the supply. Salina Creek, which enters about 15 miles above the station, is subject to rapid run-off and during flood seasons carries an immense amount of sediment.

There is considerable irrigation from the Sevier above Gunnison, and a few small storage reservoirs control the flood discharge.

SEVIER RIVER NEAR GUNNISON, UTAH.

This station was established June 29, 1900. It is located at the wagon bridge over the Sevier about 4 miles west of Gunnison, on the road to Westview precinct. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 65, where are given also references to publications that contain data for previous years.

Discharge measurements of Sevier River near Gunnison, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 25	H. S. Kleinschmidt	60	210	3.52	563
May 21	C. Tanner	78	404	5.65	1,770
May 29	Thos. Grieve, jr	79	519	6.27	2,530
July 17	do	42	126	.95	42

Daily gage height, in feet, of Sevier River near Gunnison, Utah, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	2.38	......	2.90	3.50	5.7	3.80	......	2.00	2.60	2.40	2.72
2	......	2.38	......	2.80	3.60	5.66	3.70	......	2.00	2.58	2.46	2.76
3	......	2.38	1.60	2.74	3.74	5.62	3.70	2.00	2.02	2.54	2.44	2.80
4	2.06	2.38	......	2.72	3.76	5.40	3.70	1.90	2.04	2.54	2.40	2.80
5	......	2.38	1.46	2.70	3.80	5.36	......	1.90	2.22	2.52	2.42	2.86
6	......	2.38	1.74	2.90	3.86	5.10	3.68	1.84	2.30	2.50	2.40	2.86
7	2.08	2.38	1.82	3.30	3.90	5.06	3.62	1.80	2.30	2.42	2.36	2.84
8	......	2.38	1.86	3.20	3.84	4.96	3.62	1.80	2.30	2.30	2.36	2.90
9	......	2.38	2.02	3.22	3.94	4.70	3.62	1.76	2.20	2.80	2.34	2.90
10	4.16	2.40	2.06	3.24	4.04	4.72	3.60	1.70	2.20	2.26	2.34	2.86
11	......	2.50	2.78	3.26	4.10	4.80	2.70	1.64	2.10	2.22	2.36	2.84
12	......	2.62	2.78	3.14	4.26	4.72	......	1.75	1.96	2.20	2.30	2.82
13	......	2.80	2.72	3.16	4.56	4.78	......	1.70	1.90	2.06	2.30	2.82
14	4.00	2.90	2.58	3.06	4.56	4.70	......	1.70	1.90	2.02	2.30	2.82
15	......	2.82	2.40	3.02	4.76	4.68	......	1.72	1.90	2.00	2.32	2.80
16	......	2.82	......	3.04	4.90	4.66	......	1.72	2.06	2.04	2.30	2.80
17	......	2.76	2.20	3.20	5.10	4.66	.95	1.70	2.42	2.06	2.32	2.80
18	......	2.74	2.28	3.22	5.30	4.64	1.00	1.64	2.40	2.10	2.32	2.80
19	......	2.50	2.24	3.20	5.44	4.50	1.20	1.70	2.40	2.14	......	2.82
20	3.70	2.50	2.24	3.24	5.60	4.20	1.12	1.90	2.44	2.12	2.34	2.82
21	......	2.46	2.38	3.24	5.72	4.10	1.14	2.12	2.44	2.16	2.30	2.86
22	3.00	2.40	2.44	3.26	5.86	3.90	1.22	2.20	2.40	2.20	2.34	2.84
23	......	2.20	2.50	3.40	5.90	3.78	1.24	2.20	2.60	2.20	2.34	2.80
24	2.46	2.20	2.56	3.44	6.00	3.60	1.32	2.90	2.60	2.18	2.46	2.80
25	2.44	2.08	2.70	3.50	6.06	3.46	1.24	3.10	2.60	2.20	2.60	2.82
26	2.40	2.20	2.76	3.44	6.20	3.40	1.20	2.90	2.60	2.22	2.60	2.80
27	2.40	2.00	2.84	3.34	......	3.18	1.34	2.50	2.60	2.22	2.60	......
28	......	2.00	2.90	3.34	6.34	3.10	1.34	2.36	2.60	2.24	2.64	......
29	2.40	......	2.92	3.36	......	3.04	1.34	2.26	2.62	2.26	2.66	2.84
30	......	......	2.92	3.52	6.04	2.90	......	2.26	2.62	2.26	2.66	2.84
31	......	......	2.90	......	5.86	......	......	2.20	......	2.28	......	2.84

NOTE.—Ice conditions January 1-19. Ice about 0.4 foot thick.

SEVIER RIVER NEAR MARYSVALE, UTAH.

This station was established February 18, 1906. It is located about 200 yards from the main wagon road at Peter Pitt's ranch, about 6 miles above Marysvale, which is the nearest railway station.

The channel is straight for about 200 feet above the station and 100 feet below. The right bank, which is rather low, is covered with willows; the left has gentle slope and is clean. Neither bank is subject to overflow. The current is sluggish. The bed of the stream is composed of clay and may change during flood stages. Discharge measurements are made from a car on a cable marked at 5-foot intervals with red paint. The initial point for soundings is the inner face of the cable support on the left bank.

The gage, which is read by Mr. Peter Pitts, is a 4 by 4-inch post, graduated to feet and tenths, set in a vertical position directly under the cable.

Discharge measurements of Sevier River near Marysvale, Utah, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 24	H. S. Kleinschmidt	55	221	4.85	673.0
July 19	Thos. Grieve, jr	49	128	3.94	260.0

Daily gage height, in feet, of Sevier River near Marysvale, Utah for 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	Day.	Feb.	Mar.	Apr.	May.	June.
1		2.78	2.60	5.00	7.27	17		2.50	3.00		5.40
2		2.60	2.70	4.80	6.97	18	2.73	2.55	3.25		5.30
3		2.40	2.60	4.70	6.77	19		2.50	3.40		5.10
4		2.45	2.60	4.70	6.65	20		2.45	3.60		4.95
5		2.45	2.55	4.90	6.52	21	2.70	2.52	3.75		4.80
6		2.35	2.55	5.20	6.52	22	2.70	2.55	4.00		4.70
7		2.32	2.80	5.40	6.55	23	2.50	2.55	4.30	8.57	4.40
8		2.40	2.95	5.55	6.52	24	2.50	2.60	4.70	8.47	4.20
9		2.40	2.90	5.80	6.17	25	2.50	2.80	5.00	8.42	4.00
10		2.50	2.90		6.00	26	2.50	3.05	5.10	8.17	3.80
11		2.50	2.90		6.00	27	2.35	3.00	5.00	7.87	3.75
12		2.55	2.90		6.17	28	2.60	2.80	4.90	7.85	3.65
13		2.50	2.90		5.90	29		2.70	4.90	7.92	3.60
14		2.60	2.80		5.90	30		2.70	5.10	7.97	3.40
15		2.60	2.80		5.60	31		2.65		7.59	
16		2.60	2.90		5.50						

NOTE.—May 10–22 water was over the top of the gage rod.

BEAVER CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Beaver Creek with its tributaries, North, South, and Indian creeks, rises on the western slope of the Tushar Mountains, and flows in a westerly direction to Minersville, thence northerly until its waters are lost in the sands.

Measurements were made of these streams in 1906 by Mr. J. F. Hoyt, in connection with an investigation of the water resources of the valley for irrigation purposes.

BEAVER CREEK NEAR BEAVER, UTAH.

This was a temporary station established June 15 and discontinued September 22, 1906. It was located at the mouth of Pink Stone Hollow, 5 miles east of Beaver, Utah.

Discharge measurements of Beaver Creek near Beaver, Utah, in 1906.

Month.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 13	5.35	612
July 2	4.00	164
August 14	3.35	78
August 25	3.28	62

Daily gage height, in feet, of Beaver Creek near Beaver, Utah, for 1906.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		4.0	3.6	3.2	17	4.95	3.65	3.3	3.2
2		3.95	3.55	3.25	18	4.8	3.65	3.3	3.2
3		3.95	3.5	3.2	19	4.75	3.6	3.3	3.2
4		3.95	3.4	3.2	20	4.65	3.6	3.4	3.2
5		3.9	3.4	3.2	21	4.62	3.55	3.55	3.1
6		3.9	3.4	3.2	22	4.55	3.55	3.5	3.1
7		3.85	3.4	3.15	23	4.5	3.55	3.35	
8		3.8	3.4	3.15	24	4.4	3.55	3.3	
9		3.8	3.4	3.15	25	4.35	3.5	3.3	
10		3.8	3.35	3.1	26	4.3	3.45	3.3	
11		3.75	3.35	3.1	27	4.3	3.45	3.25	
12		3.75	3.35	3.1	28	4.25	3.55	3.25	
13		3.75	3.3	3.1	29	4.12	3.5	3.25	
14		3.75	3.3	3.1	30	4.08	3.4	3.25	
15	5.2	3.7	3.3	3.1	31		3.5	3.35	
16	5.1	3.7	3.3	3.2					

Rating table for Beaver Creek near Beaver, Utah, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.10	52	3.60	103	4.10	183	4.50	269	4.90	399
3.20	59	3.70	117	4.20	202	4.60	297	5.00	439
3.30	68	3.80	132	4.30	222	4.70	328	5.10	482
3.40	78	3.90	148	4.40	244	4.80	362	5.20	528
3.50	90	4.00	165						

NOTE.—This table is based on 4 discharge measurements and is not well defined.

Monthly discharge of Beaver Creek near Beaver, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June (15–30)	528	179	300	9,520
July	165	78	117	7,190
August	103	63	74.8	4,600
September (1–22)	63	52	56.1	2,450
The period				23,800

BEAVER CREEK NEAR MINERSVILLE, UTAH.

The following measurement was made June 21, 1906, at the county bridge, 1½ miles east of Minersville. During the late summer Minersville Canal diverts most of the flow of the creek 200 feet above the bridge.

Area, 64 square feet; discharge, 211 second-feet.

MINERSVILLE CANAL AT MINERSVILLE, UTAH.

This was a temporary station established June 21 and discontinued September 21, 1906. It was located at the old flour mill flume, three-fourths of a mile east of Minersville.

The gage was fastened to the north side of the flume with the zero coinciding with the bottom.

The following measurements were made during 1906:

June 21....Gage height..1.50 feet; discharge, 41 second-feet.
August 21....Gage height..0.93 foot; discharge, 32.5 second-feet.

Daily gage height, in feet, of Minersville Canal near Minersville, Utah, for 1906.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		1.6	0.9	1.4	17			0.9	1.15
2		1.6		1.5	18		1.1		1.1
3		1.6	.9	1.4	19			.9	1.05
4				1.4	20		1.1		
5		1.6	.9	1.4	21	1.6		.9	1.0
6		1.6		1.35	22	1.6	1.1	1.0	
7		1.6	.9	1.35	23			1.1	
8		1.6		1.35	24	1.5	1.1	1.3	
9		1.6	.9	1.35	25	1.6		1.3	
10		1.6		1.3	26	1.6	1.1	1.3	
11			.9	1.3	27	1.6		1.3	
12		1.1		1.3	28		1.0	1.3	
13			.9	1.3	29	1.6		1.3	
14		1.1		1.3	30	1.6	.9	1.3	
15			.9	1.3	31			1.3	
16		1.1		1.15					

Monthly discharge of Minersville Canal near Minersville, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June (21-30)	43	41	42.7	847
July	43	32	37.3	2,290
August	38	32	33.7	2,070
September (1-21)	41	33	37.6	1,570
The period				6,780

NOTE.—These values are based on very meager data and are only approximate.

NORTH FORK OF NORTH CREEK NEAR BEAVER, UTAH.

This was a temporary station established June 16 and discontinued September 27, 1906. It was located one-half mile east of T. J. Shy's fence along the wagon road and 8 miles northeast of Beaver.

Discharge measurements of North Fork of North Creek near Beaver, Utah, in 1906.

Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 23	2.80	32.2
August 18	2.25	3.6
August 27	2.25	3.6

Daily gage height, in feet, of North Fork of North Creek, near Beaver, Utah, for 1906.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		2.0	2.2	2.25	17	2.9	2.3	2.0	2.1
2		2.6	2.2	2.32	18	2.8	2.2	2.18	2.1
3		2.6	2.2	2.22	19	2.8	2.2	2.1	2.1
4		2.6	2.1	2.35	20	3.0	2.0	2.2	2.1
5		2.6	2.1	2.36	21	2.9	2.2	2.3	2.1
6		2.5	2.1	2.35	22	2.9	2.2	2.3	2.1
7		2.5	2.1	2.34	23	2.8	2.1	2.3	2.1
8		2.5	2.1	3.24	24	2.6	2.2	2.3	2.1
9		2.5	2.1	3.25	25	2.7	2.2	2.3	2.2
10		2.5	2.1	2.0	26	2.6	2.2	2.4	2.2
11		2.5	2.1	1.9	27	2.6	2.2	2.3	2.2
12		2.4	2.0	1.95	28	2.6	2.2	2.3	
13		2.4	2.0	1.9	29	2.6	1.9	2.3	
14		2.4	2.0	1.9	30	2.6	1.9	2.32	
15		2.4	2.0	1.9	31		1.9	2.3	
16	3.0	2.4	2.0	1.9					

Monthly discharge of North Fork of North Creek, near Beaver, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June (16–30)	52	17	29.9	890
July	17	.2	6.8	418
August	7.7	.5	2.7	166
September (1–27)	84	.2	8.3	445
The period				1,910

NOTE.—These values are based on very meager data and are only approximate.

SOUTH FORK OF NORTH CREEK, NEAR BEAVER, UTAH.

This was a temporary station established June 16 and discontinued September 27, 1906. It was located 100 feet east of "The Narrows" of South Fork Canyon, 8 miles northeast of Beaver, Utah.

Discharge measurements of South Fork of North Creek, near Beaver, Utah.

	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 23	3.40	90
August 18	2.25	17.3
August 27	2.20	16.1

Daily gage height, in feet, of South Fork of North Creek, near Beaver, Utah, for 1906.

Day.	June.	July.	Aug.	Sept.	Day.	June.	July.	Aug.	Sept.
1		3.1	2.4	2.32	17	3.6	2.7	2.5	2.3
2		3.1	2.4	2.32	18	3.6	2.7	2.4	2.2
3		3.1	2.3	2.22	19	3.6	2.6	2.4	2.2
4		3.1	2.3	2.35	20	3.7	2.4	3.5	2.2
5		3.9	2.3	2.35	21	3.7	2.4	2.45	2.2
6		2.8	2.3	2.34	22	3.6	2.3	2.4	2.2
7		2.8	2.4	2.34	23	3.4	2.4	2.4	2.3
8		2.8	2.4	2.34	24	3.2	2.4	2.4	2.3
9		2.8	2.4	2.35	25	3.1	2.4	2.4	2.3
10		2.8	2.4	2.25	26	3.0	2.4	2.4	2.3
11		2.8	2.4	2.24	27	2.9	2.4	2.2	2.3
12		2.8	2.4	2.25	28	3.0	2.4	2.3	
13		2.8	2.6	2.25	29	2.9	2.4	2.3	
14		2.7	2.5	2.25	30	2.8	2.4	2.3	
15		2.7	2.5	2.25	31		2.4		
16	3.8	2.7	2.4	2.25					

Monthly discharge of South Fork of North Creek, near Beaver, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June 16-30	152	39	88.1	2,620
July	168	18	37.6	2,310
August	102	16	23.4	1,390
September 1-27	19	16	17.5	937
The period				7,260

NOTE.—These values are based on meager data and are only approximate.

SOUTH CREEK, NEAR BEAVER, UTAH.

This was a temporary station established June 18 and discontinued September 18, 1906. It was located 900 feet east of Cox Brothers' ranch house and 8 miles southeast of Beaver.

	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 18	1.20	26.8
July 6	.70	6.8
July 31	.51	2.8
August 25	.45	3.1

INDIAN CREEK, NEAR BEAVER, UTAH.

This was a temporary station established June 26 and discontinued August 31, 1906. It was located 190 feet above the head of Beaumont ditch and 12 miles north of Beaver.

Discharge measurements of Indian Creek, near Beaver, Utah.

	Gage height.	Discharge.
	Feet.	*Sec.-ft.*
June 26	0.95	21.3
August 18	.65	4.6
August 21	.61	3.9

Daily gage height, in feet, of Indian Creek, near Beaver, Utah, for 1906.

Day.	June.	July.	Aug.	Day.	June.	July.	Aug.
1			0.73	17		0.79	
2		0.88		18			0.64
3				19			
4				20			
5		.85	.70	21			.70
6		.84		22			
7				23		.71	
8			.67	24			
9				25		.71	
10		.80		26	0.95		
11			.65	27		.72	.61
12				28	.92	.73	.61
13				29			
14		.78		30	.90		
15				31		.74	.63
16							

Monthly discharge of Indian Creek, near Beaver, Utah, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
June (26-30)	21	16.5	18.4	182
July	15.5	6.3	9.4	578
August	7.0	4.0	5.1	314
The period				1,070

NOTE.—These values are based on very meager data and are only approximate.

HUMBOLDT SINK DRAINAGE.

The only stream of importance draining into Humboldt Sink is Humboldt River, the basin of which is described below.

HUMBOLDT RIVER BASIN.

DESCRIPTION OF BASIN.

Humboldt River rises in the extreme northeastern part of Nevada, flows west and southwest across the structural features of the country, and enters Humboldt Lake, whence its waters find their way into Humboldt Sink. The tributaries follow the general direction of the mountain ranges and flow either to the north or to the south. During low stages the water of the river is almost wholly diverted and for the future development of the country recourse must be had to the construction of storage reservoirs.

Of the tributaries North Fork enters the stream west of Peko, Nev., and South Fork about 10 miles below Elko. Pine Creek comes in from the south near Palisade, Nev. Marys River is one of the headwater branches.

NORTH FORK OF HUMBOLDT RIVER NEAR ELBURZ, NEV.

This station was established October 10, 1902. It is located about one-fourth mile above the junction of North Fork with the main river and 150 feet below the Southern Pacific Railroad bridge. It is

2 miles west of the Southern Pacific Railroad station at Elburz. The nearest post-office is Halleck, Nev. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 70, where are given also references to publications that contain data for previous years.

Discharge measurements of North Fork of Humboldt River near Elburz, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 28	M. B. Kennedy	40	100	4.35	176
June 25	do	40	90	4.30	122
July 9	do	37	46	3.60	60
August 7	do	35	13	2.95	11.8

Daily gage height, in feet, of North Fork of Humboldt River near Elburz, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	4.0	3.8	4.5	4.6	4.5	4.2	3.0	2.5	2.5	2.55	2.85
2	3.5	4.0	3.8	4.5	4.5	4.5	4.1	3.0	2.5	2.5	2.55	2.85
3	3.5	4.0	3.8	4.4	4.5	4.5	4.0	3.0	2.5	2.5	2.55	2.9
4	3.5	4.0	3.8	4.4	4.5	4.5	4.0	3.0	2.5	2.5	2.55	2.9
5	3.5	4.0	3.8	4.4	4.5	4.4	3.9	3.0	2.5	2.5	2.55	2.95
6	3.5	4.0	3.8	4.3	4.5	4.4	3.8	2.95	2.5	2.5	2.6	2.95
7	3.5	4.0	3.8	4.3	4.4	4.3	3.7	2.9	2.5	2.5	2.6	3.0
8	3.5	4.0	3.8	4.4	4.4	4.3	3.7	2.9	2.5	2.5	2.6	3.1
9	3.5	4.0	3.8	4.5	4.35	4.3	3.65	2.85	2.5	2.5	2.65	3.1
10	3.5	4.0	3.8	5.0	4.3	4.3	3.6	2.85	2.5	2.5	2.65	3.1
11	3.5	4.0	3.8	5.4	4.2	4.2	3.6	2.85	2.5	2.5	2.65	3.15
12	3.5	4.0	3.7	5.3	4.1	4.2	3.55	2.85	2.5	2.5	2.65	3.15
13	3.5	4.0	3.7	5.2	4.1	4.1	3.5	2.85	2.5	2.5	2.65	3.2
14	3.5	4.0	3.6	5.0	4.1	4.2	3.5	2.85	2.5	2.5	2.65	3.2
15	3.6	4.0	3.6	5.0	4.0	4.2	3.45	2.8	2.5	2.5	2.7	3.2
16	3.6	4.0	3.6	5.0	4.0	4.3	3.4	2.8	2.5	2.5	2.7	3.2
17	3.8	4.0	3.6	5.0	4.1	4.3	3.4	2.8	2.5	2.5	2.7	3.2
18	3.9	4.0	3.6	4.9	4.1	4.4	3.35	2.8	2.5	2.5	2.7	3.2
19	4.0	4.0	3.6	4.9	4.1	4.6	3.35	2.8	2.5	2.5	2.7	3.2
20	4.0	4.0	3.6	5.0	4.1	4.9	3.3	2.75	2.5	2.5	2.7	3.2
21	4.0	3.9	3.7	5.0	4.1	4.9	3.3	2.75	2.5	2.5	2.7	3.2
22	4.0	3.8	3.7	5.0	4.0	4.8	3.25	2.7	2.5	2.5	2.7	3.2
23	4.0	3.8	3.8	5.0	4.0	4.7	3.25	2.65	2.5	2.5	2.7	3.2
24	4.0	3.7	3.8	4.9	4.0	4.5	3.2	2.6	2.5	2.5	2.7	3.2
25	4.0	3.7	4.0	4.85	4.0	4.3	3.2	2.6	2.5	2.5	2.75	3.2
26	4.0	3.75	4.7	4.85	4.0	4.3	3.15	2.6	2.5	2.5	2.75	3.2
27	4.0	3.8	6.4	4.8	4.1	4.25	3.1	2.6	2.5	2.5	2.8	3.2
28	4.0	3.8	4.6	4.7	4.3	4.2	3.1	2.55	2.5	2.5	2.8	3.2
29	4.0	......	4.6	4.7	4.4	4.2	3.1	2.55	2.5	2.5	2.8	3.2
30	4.0	......	4.5	4.6	4.5	4.2	3.1	2.5	2.5	2.5	2.85	3.2
31	4.0	......	4.5	......	4.5	......	3.05	2.5	......	2.5	......	3.2

NOTE.—There was probably obstruction from ice during the winter months, to what extent is not known.

Rating table for North Fork of Humboldt River near Elburz, Nev., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft*
2.50	0	3.10	21	3.70	70	4.30	142	4.90	237
2.60	1	3.20	28	3.80	80	4.40	156	5.00	255
2.70	3	3.30	35	3.90	91	4.50	171	5.10	274
2.80	6	3.40	43	4.00	103	4.60	186	5.20	294
2.90	10	3.50	51	4.10	115	4.70	202	5.30	314
3.00	15	3.60	60	4.20	128	4.80	219	5.40	334

NOTE.—This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is not well defined.

Monthly discharge of North Fork of Humboldt River near Elburz, Nev., for 1906.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	103	51	75.6	4,650	0.074	0.09
February	103	70	95.9	5,330	.094	.10
March	202	60	95	5,840	.093	.11
April	334	142	221	13,200	.217	.24
May	186	103	134	8,240	.131	.15
June	237	115	156	9,280	.153	.17
July	128	18	52.6	3,230	.052	.06
August	15	0	65.5	403	.0064	.01
September	0	0	0	0	.000	.00
October	0	0	0	0	.000	.00
November	8	.5	2.76	164	.0027	.003
December	28	8	23.2	1,430	.023	.03
The year	334	0	71.8	51,800	.070	.96

NOTE.—The open-channel rating table was applied throughout the year; values for winter months are liable to some error on account of ice.

SOUTH FORK OF HUMBOLDT RIVER NEAR ELKO, NEV.

This station was established August 29, 1896. It is located 10 miles southwest of the town of Elko, at Cislini's (formerly Mason's) ranch, and about 6 miles above the junction of South Fork with the main stream. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, p. 72, where are given also references to publications that contain data for previous years.

Discharge measurements of South Fork of Humboldt River near Elko, Nev., for 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 27	M. B. Kennedy	42	98	3.20	427
June 23	do	45	131	4.80	571
July 10	do	44	109	3.30	424
August 8	do	14	11.4	1.00	9.9

Daily gage height, in feet, of South Fork of Humboldt River near Elko, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Oct.	Nov.	Dec.
1	1.1	1.2	2.2	3.0	2.8	3.4	3.9	1.8	......	1.1	1.1
2	1.1	1.2	2.0	2.9	2.7	3.4	3.9	1.8	......	1.1	1.1
3	1.1	1.2	2.0	2.8	2.7	3.5	3.9	1.8	1.0	1.1	1.1
4	1.1	1.2	2.0	2.7	2.8	3.6	3.8	1.8	1.0	1.1	1.1
5	1.1	1.2	1.7	2.5	2.9	3.7	3.8	1.7	1.0	1.1	1.1
6	1.1	1.2	1.7	2.5	3.0	3.8	3.8	1.6	1.0	1.1	1.1
7	1.1	1.2	1.7	2.5	3.1	3.8	3.8	1.2	1.0	1.1	1.1
8	1.1	1.2	1.8	2.6	3.2	3.9	3.7	1.0	1.0	1.1	1.1
9	1.1	1.2	1.8	2.7	3.2	4.0	3.7	1.0	1.0	1.1	1.1
10	1.1	1.2	2.0	2.8	3.4	4.0	3.7	1.0	1.0	1.1	1.1
11	1.1	1.2	2.0	2.8	3.4	4.1	3.6	......	1.0	1.1	1.1
12	1.1	1.2	2.0	2.9	3.4	4.2	3.6	......	1.0	1.1	1.1
13	1.1	2.0	2.0	3.0	3.2	4.4	3.6	......	1.0	1.1	1.1
14	1.1	2.0	1.9	3.0	3.1	4.5	3.6	......	1.0	1.1	1.1
15	1.1	2.0	1.9	3.0	3.0	4.7	3.5	......	1.0	1.1	1.1
16	1.1	2.0	1.8	3.0	3.0	5.0	3.4	......	1.0	1.1	1.1
17	1.1	2.0	1.8	3.0	3.0	5.0	3.3	......	1.0	1.1	1.1
18	1.1	2.1	1.8	3.0	2.9	5.0	3.2	......	1.0	1.1	1.1
19	1.1	2.2	2.0	3.0	2.8	5.0	3.1	......	1.0	1.1	1.1
20	1.1	2.2	2.6	3.0	2.8	5.0	3.0	......	1.0	1.1	1.1
21	1.1	2.2	2.8	3.0	2.9	5.0	2.9	......	1.1	1.1	1.1
22	1.1	2.2	2.8	3.0	3.0	5.0	2.8	......	1.1	1.1	1.1
23	1.1	2.2	3.0	3.0	3.0	5.0	2.6	......	1.1	1.1	1.1
24	1.1	2.2	3.0	3.0	3.0	5.0	2.3	......	1.1	1.1	1.1
25	1.1	2.2	3.0	3.0	3.0	4.8	2.1	......	1.1	1.1	1.1
26	1.1	2.2	3.0	3.0	3.0	4.8	2.0	......	1.1	1.1	1.1
27	1.1	2.1	3.0	2.9	3.2	4.7	1.8	......	1.1	1.1	1.1
28	1.2	2.1	2.8	2.8	3.2	4.7	1.8	......	1.1	1.1	1.1
29	1.2	......	2.8	2.8	3.2	4.7	1.8	......	1.1	1.1	1.1
30	1.2	......	2.9	2.8	3.3	4.7	1.8	......	1.1	1.1	1.1
31	1.2	......	3.0	......	3.3	......	1.8	......	1.1	1.1	1.1

NOTE.—The river was dry August 11 to October 2.

Rating table for South Fork of Humboldt River near Elko, Nev., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	10	1.80	102	2.60	250	3.40	480	4.40	965
1.10	18	1.90	118	2.70	275	3.50	515	4.60	1,100
1.20	27	2.00	135	2.80	300	3.60	555	4.80	1,240
1.30	37	2.10	153	2.90	325	3.70	595	5.00	1,400
1.40	48	2.20	171	3.00	355	3.80	640		
1.50	60	2.30	190	3.10	385	3.90	685		
1.60	73	2.40	210	3.20	415	4.00	735		
1.70	87	2.50	230	3.30	445	4.20	845		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and is not well defined.

Monthly discharge of South Fork of Humboldt River near Elko, Nev., for 1906.

[Drainage area, 1,150 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	27	18	19.2	1,180	0.017	0.02
February	171	27	101	5,610	.088	.09
March	355	87	199	12,200	.173	.20
April	355	230	320	19,000	.278	.31
May	480	275	371	22,800	.323	.37
June	1,400	480	1,020	60,700	.887	.99
July	685	102	422	25,900	.367	.42
August	102	0	20.2	1,240	.018	.02
September	0	0	0	0	.000	.00
October	18	0	12.2	750	.011	.01
November	18	18	18.0	1,070	.016	.02
December	18	18	18.0	1,110	.016	.02
The year	1,400	0	210	152,000	.183	2.47

HUMBOLDT RIVER AT PALISADE, NEV.

This station was established November 27, 1902, and discontinued October 19, 1906. It is located at the single-span highway bridge one-fourth mile from the hotel at Palisade, Nev. There is a railroad bridge about 500 feet below. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, p. 74, where are given also references to publications that contain data for previous years.

Discharge measurements of Humboldt River at Palisade, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft*
May 26	M. B. Kennedy	105	432	4.50	1,010
June 25	do	108	632	5.90	1,940
July 10	do	102	453	4.65	1,080
August 8	do	87	96	2.20	108

Daily gage height, in feet, of Humboldt River at Palisade, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.7	1.7	2.1	5.35	6.3	5.5	5.2	2.9	1.7	1.7
2	1.7	1.7	2.15	5.3	6.1	5.6	5.2	2.8	1.7	1.8
3	1.7	1.7	2.25	5.3	6.0	5.4	5.1	2.4	1.7	1.8
4	1.7	1.7	2.3	5.3	6.1	5.5	5.2	2.6	1.7	1.8
5	1.7	1.7	2.4	5.3	5.8	5.6	5.0	2.6	1.7	1.8
6	1.7	1.7	2.6	5.35	5.7	5.8	5.1	2.5	1.7	1.8
7	1.7	1.7	2.7	5.35	5.4	5.6	5.1	2.4	1.7	1.8
8	1.7	1.7	3.0	5.4	5.5	5.7	5.0	2.3	1.6	1.8
9	1.7	1.7	3.2	5.4	5.2	5.7	5.0	2.2	1.6	1.8
10	1.7	1.7	3.3	5.45	5.2	5.6	4.8	2.1	1.6	1.8
11	1.7	1.7	3.4	5.5	5.3	5.6	4.8	2.0	1.6	1.8
12	1.7	1.7	3.5	5.6	5.1	5.5	4.8	2.0	1.6	1.8
13	1.7	1.7	3.6	5.6	5.0	5.6	4.8	2.0	1.7	1.8
14	1.7	1.7	3.65	5.7	5.0	5.7	4.8	2.0	1.8	1.8
15	1.7	1.7	3.7	5.8	5.2	5.7	4.8	1.9	1.8	1.8
16	1.7	1.7	3.7	5.8	5.2	5.6	4.8	1.8	1.7	1.8
17	1.7	1.7	3.8	5.9	5.0	5.8	4.7	1.8	1.8	1.8
18	1.7	1.75	4.0	6.2	4.9	6.0	4.6	1.7	1.8	1.8
19	1.7	1.75	4.2	6.2	4.9	6.0	4.5	1.8	1.8	1.8
20	1.7	1.75	4.3	6.3	4.8	5.8	4.5	1.7	1.8	......
21	1.7	1.8	4.4	6.3	4.7	5.9	4.5	1.8	1.7	......
22	1.7	1.8	4.6	6.4	4.6	5.8	4.6	1.8	1.7	......
23	1.7	1.8	4.8	6.2	4.7	5.8	4.4	1.8	1.7	......
24	1.7	1.8	5.0	6.5	4.8	5.8	4.3	1.8	1.7	......
25	1.7	1.85	5.0	6.6	4.7	5.7	4.1	1.8	1.7	......
26	1.7	1.85	5.1	6.5	4.6	5.6	4.0	1.8	1.7	......
27	1.7	1.9	5.1	6.6	4.9	5.4	3.8	1.8	1.7	......
28	1.7	2.0	5.2	6.7	4.8	5.3	3.7	1.8	1.7	......
29	1.7	......	5.25	6.6	4.9	5.3	3.5	1.8	1.7	......
30	1.7	......	5.25	6.4	5.5	5.2	3.2	1.8	1.7	......
31	1.7	......	5.3	......	5.5	......	3.0	1.8	......	......

Rating tables for Humboldt River, at Palisade, Nev.

JANUARY 1, 1905, TO MARCH 23, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	34	1.80	139	2.50	308	3.20	534	3.90	807
1.20	46	1.90	159	2.60	337	3.30	570	4.00	850
1.30	59	2.00	180	2.70	367	3.40	607	4.20	940
1.40	72	2.10	203	2.80	398	3.50	645	4.40	1,030
1.50	86	2.20	227	2.90	430	3.60	684	4.60	1,120
1.60	102	2.30	253	3.00	463	3.70	724	4.80	1,220
1.70	120	2.40	280	3.10	498	3.80	765		

MARCH 24 TO OCTOBER 19, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1.70	30	2.60	210	3.50	530	4.40	955	5.60	1,710
1.80	42	2.70	240	3.60	570	4.50	1,010	5.80	1,860
1.90	56	2.80	270	3.70	615	4.60	1,065	6.00	2,020
2.00	72	2.90	305	3.80	660	4.70	1,120	6.20	2,180
2.10	91	3.00	340	3.90	705	4.80	1,180	6.40	2,350
2.20	111	3.10	375	4.00	750	4.90	1,240	6.60	2,530
2.30	133	3.20	410	4.10	800	5.00	1,300		
2.40	157	3.30	450	4.20	850	5.20	1,430		
2.50	182	3.40	490	4.30	900	5.40	1,565		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–5 and is fairly well defined.

[b] This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Humboldt River at Palisade, Nev., for 1906.

[Drainage area, 5,010 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft per sq. mile.	Depth in inches.
January	120	120	120	7,380	0.024	0.03
February	180	120	129	7,160	.026	.03
March	1,500	203	827	50,800	.165	.19
April	2,620	1,500	1,960	117,000	.391	.44
May	2,260	1,000	1,450	89,200	.289	.33
June	2,020	1,430	1,740	104,000	.347	.39
July	1,430	340	1,060	65,200	.212	.24
August	305	30	90.9	5,420	.018	.02
September	42	20	30.7	1,830	.0061	.01
October (1-19)	42	30	41.4	1,560	.0083	.01
The period				450,000		

NOTE.—The open-channel rating table was applied throughout the year; values for winter months are liable to some error on account of ice.

HUMBOLDT RIVER NEAR GOLCONDA, NEV.

This station was established October 24, 1894. It is located 1¼ miles north of the town of Golconda, near the great northern bend of Humboldt River and below the central valley, and is about 12 miles above the mouth of Little Humboldt River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 76, where are given also references to publications that contain data for previous years.

Discharge measurements of Humboldt River near Golconda, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 25	M. B. Kennedy	80	433	9.10	777
June 26	do	82	421	9.05	850
July 11	do	89	464	9.35	906
August 9	do	50	98	5.60	161

Daily gage height, in feet, of Humboldt River near Golconda, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1								6.4	4.2	3.7		4.1
2	2.7		6.2	8.6	10.8	8.8	9.8					
3		5.4	6.3						4.2	3.6	3.7	4.1
4	2.7	5.4		8.9		8.8	9.9	6.2				
5	2.7	5.4	6.2		10.7				4.1		3.7	4.1
6	2.7			9.1		8.9		6.1		3.6		
7		5.4	6.2	9.4	10.3		9.9				3.7	
8		5.4			10.2	9.0			4.1	3.5		4.1
9	2.7			9.6	10.0	9.0	9.8					
10	2.7		6.3						4.0	3.5	3.8	4.2
11	2.7			9.8	9.7	9.1	9.7	5.6				
12	3.0	5.2	6.6		9.6				3.9		3.8	4.2
13			6.4	10.0		9.1		5.4		3.5		
14		5.4	6.6	10.4	9.5		9.6				3.8	
15	3.0				9.5			5.2	3.7	3.5		4.7
16	3.0	5.6	6.5	10.6	9.4	9.1	9.1					
17	2.7	5.8	6.5						3.7	3.5	3.8	4.8
18	3.6			10.6	9.3	9.1	8.7	4.9				
19		6.0	6.6		9.3				3.7		3.8	4.8
20						9.1		4.8		3.5		
21		6.2	6.8	10.6	9.3		7.4				3.8	
22	3.0					9.1		4.7	3.8	3.5		4.8
23	3.6	6.4	7.0	10.6	9.2	9.0	7.2					
24	3.0		7.3		9.1				3.8	3.5	3.8	4.9
25	3.5			10.9		9.0	7.1	4.6				
26	3.9	5.9	7.5	10.9	9.0				3.7		3.9	5.0
27						10.0		4.5		3.5		
28		6.1	7.9	10.9	9.0		7.0				4.0	
29					9.0			4.4	3.7	3.6		5.0
30	5.4			10.9	8.9	9.7	6.8					
31			8.4		8.8		6.6			3.6		5.1

Rating table for Humboldt River near Golconda, Nev., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.70	0	3.70	17	4.70	77	5.70	171	7.40	420
2.80	0.2	3.80	21	4.80	85	5.80	182	7.60	460
2.90	.5	3.90	26	4.90	93	5.90	194	7.80	500
3.00	1	4.00	31	5.00	102	6.00	206	8.00	540
3.10	2	4.10	36	5.10	111	6.20	231	8.20	580
3.20	3	4.20	42	5.20	120	6.40	258	8.40	640
3.30	5	4.30	48	5.30	130	6.60	286	8.60	690
3.40	7	4.40	55	5.40	140	6.80	315	8.80	740
3.50	10	4.50	62	5.50	150	7.00	345	9.00	800
3.60	13	4.60	69	5.60	160	7.20	380	10.00	1,100

NOTE.—This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is fairly well defined above gage height 5 feet; below this it is only roughly approximate.

Monthly discharge of Humboldt River near Golconda, Nev., for 1906.

[Drainage area, 10,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	140	0	20.0	1,230	0.0019	0.002
February	258	120	172	9,550	.016	.02
March	640	231	324	19,900	.030	.03
April	1,420	690	1,160	69,000	.107	.12
May	1,400	740	1,000	61,500	.093	.11
June	1,100	740	836	49,700	.077	.09
July	1,070	286	704	43,300	.065	.07
August	258	55	131	8,060	.012	.01
September	42	17	26.2	1,560	.0024	003
October	17	10	11.4	701	.0011	.001
November	31	17	21.2	1,260	.002	.002
December	111	36	69.1	4,250	.0064	.01
The year	1,420	0	373	270,000	.034	.47

NOTE.—In January, February, and May discharges were interpolated on days when gage was not read; for other months the mean discharge of days when gage was read was taken as the mean for the month. The open-channel rating was applied throughout the year; values for the winter months are liable to some error on account of ice.

HUMBOLDT RIVER NEAR OREANA, NEV.

This station was established January 27, 1896. It is located near Oreana, Nev., about 12 miles northeast of Lovelocks. The results of the observations at this locality show the amount of water available for storage at the possible reservoir sites in the vicinity of Humboldt station, and also for the six canal systems now in operation below Oreana. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 79, where are given also references to publications that contain data for previous years.

Discharge measurements of Humboldt River near Oreana, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 24	M. B. Kennedy	100	269	4.62	586
June 27	do	100	289	4.90	625
July 12	do	100	341	5.45	807
August 10	do	100	143	3.45	261

Daily gage height, in feet, of Humboldt River near Oreana, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	2.45	2.35	3.4	5.65	5.25	5.5	4.25	2.5	2.1	2.5	2.25
2	2.4	2.4	2.45	3.5	5.65	5.25	5.5	4.2	2.5	2.1	2.5	2.3
3	2.35	2.4	2.5	3.55	5.7	5.9	5.2	4.1	2.5	2.2	2.5	2.3
4	2.35	2.45	2.55	3.6	5.7	5.9	5.25	3.9	2.45	2.2	2.25	2.3
5	2.35	2.5	2.55	3.85	5.7	5.9	5.2	3.85	2.45	2.1	2.15	2.35
6	2.35	2.5	2.6	3.9	5.55	5.95	5.2	3.85	2.4	2.1	2.1	2.35
7	2.35	2.45	2.6	4.0	5.65	5.9	5.3	3.8	2.4	2.05	2.1	2.35
8	2.35	2.45	2.6	4.1	5.65	4.1	5.3	3.75	2.35	2.05	2.1	2.4
9	2.4	2.4	2.65	4.1	5.7	4.5	5.3	3.75	2.35	2.0	2.1	2.65
10	2.4	2.4	2.7	4.2	5.8	4.2	5.35	3.6	2.3	2.0	2.1	2.65
11	2.4	2.4	2.7	4.25	5.85	4.25	5.35	3.6	2.3	2.1	2.1	2.65
12	2.45	2.45	2.7	4.35	5.9	4.4	5.4	3.5	2.3	2.1	2.1	2.7
13	2.5	2.4	2.7	4.4	5.9	4.4	5.45	3.35	2.3	2.1	2.1	2.75
14	2.5	2.35	2.65	4.6	5.9	4.5	5.5	3.3	2.35	2.0	2.5	2.85
15	2.55	2.35	2.65	4.65	5.85	4.0	5.5	3.2	2.35	2.0	2.5	2.9
16	2.6	2.3	2.65	4.7	5.8	4.0	5.5	3.15	2.3	2.0	2.1	2.95
17	2.7	2.2	2.65	4.8	5.5	4.2	5.4	3.5	2.25	2.0	2.1	2.95
18	2.75	2.1	2.7	4.95	5.35	4.8	5.35	3.5	2.25	2.0	2.1	2.9
19	2.8	2.1	2.7	5.0	5.2	4.85	5.35	3.0	2.2	2.0	2.1	2.85
20	2.9	2.5	2.75	5.5	5.4	4.7	5.3	2.9	2.2	2.0	2.1	2.8
21	2.9	2.5	2.75	5.1	5.5	4.7	5.2	2.9	2.25	2.1	2.15	2.75
22	2.9	2.1	2.8	5.1	5.2	5.2	5.15	2.85	2.25	2.1	2.15	2.75
23	2.9	2.1	2.85	5.15	4.9	5.4	5.1	2.7	2.2	2.1	2.15	2.7
24	2.85	2.15	2.9	5.2	4.5	5.1	5.1	2.7	2.15	2.5	2.1	2.7
25	2.85	2.15	2.95	5.25	4.55	5.1	5.0	2.6	2.2	2.0	2.35	2.65
26	2.75	2.2	3.5	5.35	4.5	5.5	4.8	2.6	2.2	2.0	2.3	2.55
27	2.7	2.2	3.2	5.4	4.8	4.5	4.55	2.65	2.1	2.0	2.3	2.5
28	2.6	2.3	3.2	5.5	5.1	4.1	4.35	2.6	2.1	2.5	2.3	2.45
29	2.4	......	3.25	5.6	5.4	4.0	4.35	2.55	2.95	2.5	2.3	2.45
30	2.4	......	3.25	5.65	5.3	3.9	4.3	2.55	2.5	2.5	2.25	2.45
31	2.45	......	3.3	......	5.3	......	4.3	2.5	......	2.5	......	2.45

NOTE.—There was probably no material obstruction by ice during 1906.

Rating tables for Humboldt River near Oreana, Nev.

JANUARY 1, 1905, TO APRIL 6, 1906.[a]

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	0	1.70	12	2.30	82	2.90	193	3.50	335
1.20	0.5	1.80	20	2.40	98	3.00	215	3.60	360
1.30	1	1.90	29	2.50	115	3.10	238	3.70	385
1.40	2	2.00	40	2.60	133	3.20	261	3.80	412
1.50	3.5	2.10	53	2.70	152	3.30	285	3.90	440
1.60	7	2.20	67	2.80	172	3.40	310		

APRIL 7 TO DECEMBER 31, 1906.[b]

2.00	16	2.80	124	3.60	296	4.40	500	5.40	820
2.10	26	2.90	143	3.70	320	4.50	530	5.60	890
2.20	37	3.00	163	3.80	345	4.60	560	5.80	960
2.30	49	3.10	183	3.90	370	4.70	590	6.00	1,030
2.40	62	3.20	204	4.00	395	4.80	620		
2.50	75	3.30	226	4.10	420	4.90	650		
2.60	90	3.40	249	4.20	445	5.00	680		
2.70	106	3.50	272	4.30	470	5.20	730		

[a] This table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1905 and is fairly well defined between gage heights 1.6 feet and 3.0 feet.

[b] This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and the form of the 1905 curve and is well defined above gage height 3 feet. Below gage height 3 feet it is uncertain.

Monthly discharge of Humboldt River near Oreana, Nev., for 1906.

[Drainage area, 13,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	193	90	129	7,930	0.0094	0.01
February	115	53	87.7	4,870	.0064	.007
March	335	90	172	10,600	.012	.01
April	908	310	595	35,400	.043	.05
May	995	530	835	51,300	.060	.07
June	1,010	370	638	38,000	.046	.05
July	855	470	735	45,200	.053	.06
August	458	75	229	14,100	.017	.02
September	153	26	54.1	3,220	.0039	.004
October	75	16	30.4	1,870	.0022	.003
November	75	26	40.2	2,390	.0029	.003
December	153	43	93.2	5,730	.0068	.008
The year	1,010	16	303	221,000	.022	.30

NOTE.—The open-channel rating table was applied throughout the year; values for the winter months are liable to some error on account of ice.

SIERRA NEVADA DRAINAGE.

PRINCIPAL STREAMS.

The Sierra Nevada drainage area includes the western part of Nevada, the eastern part of California, and a small part of south-central Oregon. The principal rivers of the area, with the bodies of water into which they discharge, are the following: Truckee River into Pyramid and Winnemucca lakes, Walker River into Walker Lake, Carson River into Carson Sink, Susan River into Honey Lake, and Owens River into Owens Lake.

TRUCKEE RIVER BASIN.

DESCRIPTION OF BASIN.

Upper Truckee River rises on the eastern slopes of the Sierra Nevada, in Eldorado County, Cal., and flows northward, entering Lake Tahoe from the south. The main Truckee leaves the lake, of which it forms the outlet, at the town of Tahoe, in eastern Placer County, Cal., flows north and northeast, and discharges, in Washoe County, Nev., into Pyramid and Winnemucca lakes, which have no outflowing streams. The drainage basin is wild and mountainous, the highest peaks reaching altitudes exceeding 10,000 feet. Lake Tahoe, which lies at an elevation of 6,225 feet above sea, has an area of 193 square miles and is the largest body of fresh water in the United States at this altitude.

In the lower part of its course the Truckee receives several important tributaries, among which may be mentioned Donner and Prosser creeks and Little Truckee River, the latter uniting with the main stream at the town of Boca. Independence Creek is a branch of the Little Truckee.

TRUCKEE RIVER AT TAHOE, CAL.

This station was established June 17, 1900, with a view to ascertaining the actual overflow from Lake Tahoe and the real value of the lake as a storage reservoir. It is located at the city of Tahoe. About 500 feet from the lake there is a timber dam across the river, which has been maintained for more than twenty years for the purpose of controlling the discharge from the lake. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 88, where are given also references to publications that contain data for previous years.

Discharge measurements of Truckee River at Tahoe, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 2	M. B. Kennedy	75	317	2.90	785
August 4	do	74	203	2.50	552

Daily gage height, in feet, of Truckee River at Tahoe, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.4	2.0	2.1	2.25	2.4	2.45	2.9	3.0	3.2	2.0	2.95	2.7
2	1.4	2.0	2.1	2.25	2.4	2.45	2.9	3.0	3.2	2.8	2.95	2.7
3	1.4	2.0	2.1	2.25	2.4	2.45	2.9	3.0	3.2	2.7	2.95	2.7
4	1.4	2.0	2.1	2.25	2.4	2.45	2.9	....	3.2	2.7	2.95	2.7
5	1.4	2.0	2.1	2.3	2.4	2.45	2.9	2.55	3.2	2.7	2.95	2.7
6	1.4	2.0	2.1	2.3	2.4	2.45	2.9	2.55	3.2	2.7	2.95	2.7
7	1.4	2.0	2.1	2.3	2.5	2.45	2.9	2.55	3.2	2.8	2.95	2.6
8	1.4	2.0	2.1	2.3	2.28	2.45	2.9	2.55	3.2	2.8	2.95	2.6
9	1.4	1.95	2.1	2.3	2.28	2.85	2.9	2.55	3.2	2.8	2.95	2.6
10	1.4	1.95	2.1	2.3	2.6	2.85	3.0	3.1	3.2	3.2	2.95	2.7
11	1.4	1.95	2.1	2.3	2.6	2.45	3.0	3.1	3.2	3.2	2.95	2.7
12	1.4	1.95	2.2	2.3	2.6	2.7	3.0	3.1	3.2	3.2	2.95	2.7
13	1.5	1.95	2.2	2.3	2.6	2.7	3.0	3.1	3.2	3.2	2.95	2.7
14	1.5	1.95	2.2	2.3	2.6	2.6	3.0	3.1	3.2	3.2	2.95	2.7
15	1.6	2.0	2.2	2.3	2.65	2.6	3.0	3.1	2.95	3.2	2.95	2.9
16	1.6	2.0	2.2	2.3	2.65	2.6	3.0	3.1	2.95	3.2	2.95	2.9
17	1.7	2.0	2.2	2.3	2.7	2.6	3.0	3.1	2.95	3.2	2.9	2.9
18	1.8	2.0	2.2	2.3	2.7	2.6	3.0	3.25	2.95	3.2	2.9	2.9
19	1.8	2.0	2.2	2.3	2.7	2.6	3.0	3.25	2.95	3.2	2.9	2.9
20	1.9	2.0	2.2	2.3	2.7	2.6	3.0	3.25	2.95	3.1	2.9	2.8
21	1.9	2.0	2.2	2.3	2.7	2.6	3.0	3.25	2.95	3.1	2.85	2.8
22	2.0	2.1	2.2	2.35	2.75	2.6	3.0	3.25	2.95	3.1	2.85	2.8
23	2.0	2.1	2.2	2.35	2.75	2.6	3.0	3.2	2.95	3.1	2.85	2.8
24	2.0	2.1	2.2	2.35	2.75	2.6	3.0	3.2	2.9	2.95	2.85	2.8
25	2.0	2.1	2.2	2.35	2.4	2.6	3.0	3.2	2.9	2.95	2.85	2.8
26	2.0	2.1	2.2	2.35	2.15	2.6	3.0	3.2	2.9	2.95	2.85	2.8
27	2.0	2.1	2.2	2.35	2.0	2.9	3.0	3.2	2.9	2.95	2.75	2.8
28	2.0	2.1	2.2	2.35	2.0	2.9	3.0	3.2	2.9	2.95	2.75	2.8
29	2.0	....	2.2	2.35	2.0	2.9	3.0	3.18	2.9	2.95	2.75	2.85
30	2.0	....	2.2	2.35	2.0	2.9	3.0	3.18	2.9	2.95	2.7	2.85
31	2.0	....	2.25	....	2.45	....	3.0	3.18	....	2.95	....	2.9

Rating table for Truckee River at Tahoe, Cal., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.30	15	1.00	139	1.70	306	2.40	518	3.10	776
.40	31	1.10	160	1.80	334	2.50	552	3.20	817
.50	47	1.20	182	1.90	363	2.60	586	3.30	859
.60	64	1.30	205	2.00	392	2.70	622		
.70	82	1.40	229	2.10	422	2.80	659		
.80	100	1.50	253	2.20	453	2.90	697		
.90	119	1.60	279	2.30	485	3.00	736		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and the form of previous curves, and is not well defined.

Monthly discharge of Truckee River near Tahoe, Cal., for 1906.

[Drainage area 519 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	392	229	304	18,700	0.586	0.68
February	422	378	396	22,000	.763	.79
March	469	422	443	27,200	.854	.98
April	502	469	488	29,000	.940	1.05
May	640	392	543	33,400	1.05	1.21
June	697	535	594	35,300	1.14	1.27
July	736	697	725	44,600	1.40	1.61
August	838	552	753	46,300	1.45	1.67
September	817	697	759	45,200	1.46	1.63
October	817	392	726	44,600	1.40	1.61
November	716	622	695	41,400	1.34	1.50
December	697	586	647	39,800	1.25	1.44
The year	838	229	589	428,000	1.14	15.44

NOTE.—The open-channel rating table was applied throughout the year; values for winter months are liable to some error on account of ice.

TRUCKEE RIVER AT NEVADA-CALIFORNIA STATE LINE.

This station was established September 7, 1899. It is located at the State line, 17 miles west of Reno, Nev. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 86, where are given also references to publications that contain data for previous years.

Discharge measurements of Truckee River at Nevada-California State line in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 24	C. L. Smith	72	304	2.50	759
May 23	M. B. Kennedy	90	544	4.60	2,480
June 21	do	90	648	5.30	3,140
July 3	do	90	613	4.95	2,710
July 30	do	73	334	3.10	1,000

Google

Daily gage height, in feet, of Truckee River at Nevada-California State line for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	2.30	2.70	3.58	5.92	4.00	4.85	2.85	2.75	2.35	2.75	2.50
2	1.80	2.28	2.65	3.48	6.85	4.25	4.98	2.90	2.75	2.38	2.65	2.48
3	1.80	2.30	2.62	3.22	6.85	4.65	5.00	2.90	2.62	2.50	2.65	2.48
4	1.72	2.28	2.58	3.08	6.82	5.08	4.90	2.85	2.60	2.50	2.98	2.52
5	1.72	2.25	2.52	3.00	7.15	5.05	4.95	2.65	2.65	2.48	2.78	2.50
6	1.75	2.35	2.50	3.35	7.08	4.65	4.98	2.60	2.68	2.48	2.70	2.45
7	1.75	2.35	2.50	3.50	7.18	4.45	4.60	2.65	2.65	2.50	2.68	2.45
8	1.85	2.30	2.55	3.90	7.15	4.30	4.68	2.60	2.65	2.50	2.65	2.48
9	1.95	2.30	2.60	4.20	7.18	4.88	4.50	2.65	2.65	2.50	2.68	2.45
10	2.00	2.30	2.72	4.22	6.85	5.25	4.25	2.70	2.65	2.58	2.68	2.68
11	1.95	2.30	2.85	3.98	6.98	6.25	4.20	2.80	2.65	2.75	2.70	2.60
12	1.98	2.48	3.72	4.00	6.60	5.90	4.20	2.85	2.65	2.65	2.65	2.62
13	2.00	2.40	3.05	4.10	6.35	5.20	4.22	2.90	2.65	2.72	2.70	2.65
14	1.98	2.38	2.78	4.28	6.40	5.05	4.20	2.80	2.65	2.75	2.68	2.65
15	2.05	2.52	2.82	4.55	6.25	5.10	4.00	2.80	2.65	2.68	2.70	2.65
16	2.18	2.52	2.80	6.95	5.88	5.55	3.88	2.80	2.68	2.65	2.70	2.60
17	2.22	2.52	2.80	6.00	5.68	5.55	3.70	2.70	2.65	2.65	2.65	2.58
18	2.90	2.55	2.78	5.98	5.25	5.02	3.42	2.80	2.65	2.65	2.65	2.60
19	3.18	2.85	2.82	6.08	4.80	5.22	3.60	2.75	2.62	2.65	2.60	2.60
20	2.80	2.90	2.78	6.05	4.88	5.32	3.50	2.85	2.65	2.62	2.55	2.60
21	2.68	2.70	2.85	6.60	4.70	5.50	3.45	2.80	2.62	2.65	2.60	2.60
22	2.68	2.72	3.15	6.80	4.78	5.35	3.40	2.85	2.60	2.52	2.60	2.60
23	2.62	2.70	3.25	6.75	4.62	5.20	3.40	2.78	2.65	2.52	2.58	2.60
24	2.58	2.70	3.45	5.90	4.40	5.20	3.35	2.78	2.65	2.60	2.50	2.62
25	2.52	2.68	3.52	5.70	4.40	5.02	3.35	2.75	2.65	2.60	2.50	2.68
26	2.50	2.68	3.50	5.88	4.82	4.92	3.68	2.75	2.62	2.62	2.55	2.98
27	2.50	2.68	3.40	5.82	4.55	4.90	3.30	2.75	2.62	2.70	2.50	2.92
28	2.48	2.70	3.48	4.70	4.20	4.45	3.30	2.80	2.62	2.45	2.45	2.85
29	2.42	....	3.40	4.35	4.02	4.28	3.15	2.80	2.60	2.42	2.52	2.80
30	2.35	....	3.45	4.80	3.92	4.20	3.05	2.80	2.60	2.55	2.52	2.78
31	2.20	....	3.90	....	3.80	....	3.00	2.75	....	2.62	....	2.75

Rating tables for Truckee River at Nevada-California State line.

JANUARY 1, 1905, to APRIL 15, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	300	2.60	810	3.50	1,580	4.40	2,470	5.60	3,850
1.80	346	2.75	884	3.60	1,676	4.50	2,580	5.80	4,090
1.90	394	2.80	961	3.70	1,772	4.60	2,690	6.00	4,330
2.00	444	2.90	1,042	3.80	1,870	4.70	2,800	6.20	4,570
2.10	496	3.00	1,126	3.90	1,970	4.80	2,910	6.40	4,810
2.20	551	3.10	1,213	4.00	2,070	4.90	3,020		
2.30	610	3.20	1,302	4.10	2,170	5.00	3,130		
2.40	673	3.30	1,393	4.20	2,270	5.20	3,370		
2.50	740	3.40	1,486	4.30	2,370	5.40	3,610		

APRIL 16 TO DECEMBER 31, 1906.[b]

2.30	460	3.10	995	3.90	1,700	4.70	2,500	6.00	3,950
2.40	520	3.20	1,075	4.00	1,800	4.80	2,600	6.20	4,190
2.50	580	3.30	1,155	4.10	1,900	4.90	2,710	6.40	4,430
2.60	645	3.40	1,240	4.20	2,000	5.00	2,820	6.60	4,670
2.70	710	3.50	1,325	4.30	2,100	5.20	3,040	6.80	4,920
2.80	780	3.60	1,415	4.40	2,200	5.40	3,260	7.00	5,180
2.90	850	3.70	1,510	4.50	2,300	5.60	3,480	7.20	5,440
3.00	920	3.80	1,605	4.60	2,400	5.80	3,710		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1906 and is well defined.

[b] This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and the form of the previous curve, and is fairly well defined above gage heights 3 feet.

Monthly discharge of Truckee River at Nevada-California State line for 1906.

[Drainage area, 955 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,290	309	592	36,400	0.620	0.71
February	1,040	580	746	41,400	.781	.81
March	1,970	740	1,130	69,500	1.18	1.36
April	5,120	1,130	2,850	170,000	2.98	3.32
May	5,410	1,600	3,650	224,000	3.82	4.40
June	4,250	1,800	2,830	168,000	2.96	3.30
July	2,820	920	1,800	111,000	1.88	2.17
August	850	645	763	46,900	.799	.92
September	745	645	675	40,200	.707	.79
October	745	490	629	38,700	.659	.76
November	906	550	670	39,900	.702	.78
December	906	550	662	40,700	.693	.80
The year	5,410	309	1,420	1,030,000	1.48	20.12

NOTE.—The open-channel rating tables were applied throughout the year; values for the winter months are liable to some error on account of ice.

DONNER CREEK NEAR TRUCKEE, CAL.

Donner Creek flows from the east end of Donner Lake eastward into Truckee River.

The gaging station was established October 23, 1902. It is located about 150 feet below the dam of the Donner Creek Ice Company and 1½ miles west of Truckee, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 97, where are given also references to publications that contain data for previous years.

Discharge measurements of Donner Creek near Truckee, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 31	M. B. Kennedy	36	76	3.40	323
June 29	do	37	81	3.60	330
August 1	do	17	18	1.65	35

Daily gage height, in feet, of Donner Creek near Truckee, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	1.9	2.05	2.6	3.55	3.55	3.05	1.75	1.2	1.2	1.0	1.1
2	1.9	1.9	2.0	2.6	3.65	3.65	4.0	1.65	1.2	1.2	1.0	1.1
3	1.9	1.9	2.0	2.65	3.8	3.85	4.0	1.6	1.1	1.2	1.0	1.1
4	1.9	1.9	2.0	2.7	4.25	4.1	4.0	1.55	1.1	1.2	1.45	1.1
5	1.9	1.9	2.05	2.7	4.55	4.1	3.85	1.5	1.1	1.2	1.45	1.1
6	1.9	1.0	2.1	2.75	4.6	4.0	3.8	1.5	1.1	1.2	1.35	1.1
7	1.9	1.9	2.1	2.8	4.6	4.0	3.7	1.5	1.1	1.2	1.25	1.15
8	1.9	1.9	2.1	2.8	4.6	4.05	3.7	1.5	1.1	1.2	1.2	1.25
9	1.9	1.9	2.1	2.8	4.55	4.15	3.6	1.5	1.1	1.2	1.2	1.35
10	2.0	1.9	2.2	2.8	4.3	4.2	3.45	1.45	1.1	1.2	1.2	1.5
11	2.0	1.9	2.2	2.85	4.2	4.5	3.3	1.4	1.1	1.2	1.2	1.55
12	2.0	1.9	2.3	2.9	4.1	4.7	3.4	1.4	1.1	1.2	1.2	1.5
13	3.75	1.9	2.3	2.95	4.15	4.5	3.45	1.4	1.1	1.2	1.2	1.4
14	2.0	1.9	2.3	3.0	4.15	4.1	3.3	1.4	1.1	1.2	1.2	1.4
15	1.95	1.95	2.3	3.05	4.0	4.1	3.3	1.35	1.1	1.2	1.35	1.4
16	1.8	2.0	2.3	3.1	3.9	4.4	3.3	1.3	1.1	1.2	1.55	1.3
17	1.95	2.0	2.3	3.15	3.8	4.25	3.3	1.3	1.1	1.2	1.4	1.3
18	2.05	2.1	2.3	3.25	3.95	4.05	3.3	1.25	1.15	1.2	1.3	1.3
19	2.2	2.35	2.35	3.3	4.2	4.05	3.3	1.2	1.2	....	1.3	1.2
20	2.2	2.25	2.4	3.35	4.5	4.25	3.2	1.2	1.2	....	1.25	1.2
21	2.2	2.2	2.45	3.55	4.75	4.3	3.2	1.2	1.2	....	1.2	1.2
22	2.15	2.2	2.5	3.6	4.65	4.2	3.1	1.2	1.2	....	1.2	1.2
23	2.05	2.2	2.5	3.55	4.55	4.25	2.95	1.2	1.2	....	1.2	1.35
24	2.05	2.2	2.5	3.4	4.3	4.2	2.7	1.2	1.2	....	1.2	1.45
25	2.05	2.2	2.5	3.25	4.05	4.15	2.45	1.2	1.2	1.0	1.2	1.55
26	2.1	2.2	2.5	3.2	4.05	3.95	2.25	1.2	1.2	1.0	1.2	1.75
27	2.1	2.2	2.5	3.2	3.85	3.8	2.15	1.2	1.2	1.0	1.2	1.55
28	2.05	2.1	2.5	3.2	3.75	3.85	2.05	1.2	1.2	1.0	1.1	1.4
29	2.0	....	2.55	3.2	3.7	3.9	2.0	1.2	1.2	1.0	1.1	1.3
30	2.0	....	2.6	3.2	3.7	3.95	1.9	1.2	1.2	1.0	1.1	1.3
31	2.0	....	2.6	....	3.55	....	1.85	1.2	....	1.0	....	1.3

NOTE.—The ice ponds were being filled October 19 to 24, and there was practically no flow at the station

Rating tables for Donner Creek near Truckee, Cal.

JANUARY 1, 1905, TO APRIL 30, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	0.0	1.40	5.7	2.00	29	2.60	86	3.20	185
.80	0.1	1.50	8.3	2.10	35	2.70	100	3.30	206
.90	.2	1.60	11.5	2.20	43	2.80	115	3.40	227
1.00	.5	1.70	15	2.30	52	2.90	131	3.50	248
1.10	1.1	1.80	19	2.40	62	3.00	148	3.60	269
1.20	2.0	1.90	24	2.50	73	3.10	166	3.70	290
1.30	3.5								

MAY 1 TO DECEMBER 31, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1.00	9	1.80	45	2.60	142	3.40	307	4.20	520
1.10	12	1.90	53	2.70	159	3.50	330	4.30	550
1.20	15	2.00	62	2.80	177	3.60	354	4.40	580
1.30	19	2.10	72	2.90	196	3.70	379	4.50	610
1.40	23	2.20	84	3.00	217	3.80	405	4.60	645
1.50	27	2.30	97	3.10	239	3.90	432	4.70	680
1.60	32	2.40	111	3.20	261	4.00	460	4.80	715
1.70	38	2.50	126	3.30	284	4.10	490		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined

[b] This table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and the form of the 1905 curve and is not well defined.

Monthly discharge of Donner Creek near Truckee, Cal., for 1906.

[Drainage area, 30 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	300	19	38.3	2,360	1.28	1.48
February	57	24	32.0	1,780	1.07	1.11
March	86	29	54.5	3,350	1.82	2.10
April	269	86	161	9,580	5.37	5.99
May	698	342	506	31,100	16.87	19.45
June	680	342	493	29,300	16.43	18.33
July	460	49	269	16,500	8.97	10.34
August	42	15	21.4	1,320	.713	.82
September	15	12	13.5	803	.450	.50
October[a]	15	0	11.1	682	.370	.43
November	30	9	16.3	970	.543	.61
December	42	12	20.0	1,230	.667	.77
The year	698	0	136	99,000	4.55	61.93

[a] Mean discharge estimated 7 second-feet October 19, and 5 second-feet October 24.

NOTE.—The open-channel rating was applied throughout the year; values for the winter months are liable to some error on account of ice.

TRUCKEE RIVER AT VISTA, NEV.

This station was established August 18, 1899. It is located 7 miles east of Reno, Nev., and one-fourth mile from the Southern Pacific Railroad station at Vista. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 84, where are given also references to publications that contain data for previous years.

Discharge measurements of Truckee River at Vista, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 25	C. L. Smith	113	485	5.10	896
May 22	M. B. Kennedy	120	796	8.10	3,150
June 19	do	119	862	8.50	3,290
July 5	do	120	890	8.20	3,370
July 28	do	115	561	6.00	1,420

Daily gage height, in feet, of Truckee River at Vista, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	4.8	5.0	6.7	8.2	6.8	7.8	5.4	4.9	4.7	5.2	4.9
2	4.0	4.8	5.0	6.6	8.9	7.3	8.0	5.0	4.8	4.3	5.2	4.9
3	3.9	4.8	5.0	6.3	9.4	7.3	8.0	5.1	4.8	4.6	5.1	4.9
4	4.0	4.7	5.0	5.9	9.4	8.0	8.3	5.0	4.7	4.6	5.4	4.8
5	4.0	4.7	5.0	5.7	9.7	8.4	8.3	4.7	4.7	4.6	5.8	4.9
6	4.0	4.7	5.0	6.0	9.8	8.0	8.2	4.6	4.8	4.6	5.3	4.9
7	4.0	4.7	5.0	6.5	9.9	7.4	8.0	4.5	4.7	4.7	5.2	4.9
8	4.0	4.7	5.1	7.0	9.9	7.3	8.0	4.6	4.7	4.7	5.2	5.1
9	4.1	4.7	5.2	7.4	9.8	7.7	7.8	4.6	4.7	4.7	5.2	5.0
10	4.1	4.7	5.2	7.7	9.7	8.0	7.5	4.6	4.7	4.7	5.2	5.0
11	4.2	4.7	5.4	7.4	9.6	8.5	7.3	5.0	4.7	4.9	5.2	5.7
12	4.5	4.8	5.9	7.3	9.8	9.2	7.2	4.9	4.7	5.0	5.2	5.9
13	5.4	4.8	6.0	7.4	9.6	9.0	7.2	4.9	4.7	5.0	5.2	5.5
14	5.8	4.8	5.8	7.4	9.6	8.7	7.2	4.9	4.7	5.2	5.2	5.3
15	5.0	5.0	5.4	8.0	9.3	8.6	7.2	4.8	4.9	5.0	5.2	5.3
16	5.4	5.0	5.4	8.4	8.8	8.6	7.0	4.8	4.9	5.0	5.3	5.2
17	5.7	5.0	5.4	8.6	8.0	8.9	6.5	4.8	4.9	5.0	5.2	5.2
18	7.6	5.0	5.4	8.6	8.0	8.6	6.5	4.7	4.9	5.0	5.1	5.2
19	7.5	5.0	5.4	8.6	7.8	8.6	6.2	4.7	4.8	4.9	5.0	5.2
20	6 5	5.2	5.4	8.7	8.0	8.6	6.0	4.7	4.8	4.9	5.0	5.2
21	5.6	5.4	5.3	8.9	8.0	8.6	6.0	4.9	4.8	5.0	5.0	5.1
22	5.3	5.4	5.6	9.2	8.0	8.6	5.9	4.8	4.7	5.0	5.0	5.1
23	5.4	5.4	6.0	9.3	7.6	8.6	5.8	4.8	5.2	5.0	5.0	5.2
24	5.2	5.2	6.4	9.0	7.5	8.4	6.0	4.7	4.9	5.0	5.0	5.2
25	5.1	5.1	6.7	8.6	7.3	8.4	6.0	4.7	4.8	5.0	5.0	5.3
26	5.0	5.1	6.5	8.0	8.0	8.4	6.3	4.7	4.8	5.0	5.0	5.7
27	5.0	5.1	6.3	7.9	7.4	8.3	6.5	4.8	5.0	5.2	5.0	5.7
28	5.0	5.0	6.3	7.7	7.4	7.8	6.0	4.8	4.7	5.2	5.0	5.6
29	4.9	....	6.3	7.7	7.2	7.7	5.9	4.8	4.7	4.5	4.9	5.6
30	4.9	....	6.3	7.8	7.0	7.5	5.7	4.8	4.7	4.9	4.9	5.3
31	4.8	....	7.1	....	6.8	....	5.6	4.9	....	5.2	....	5.3

Rating table for Truckee River at Vista, Nev., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.90	325	4.90	775	5.90	1,345	6.90	2,080	8.80	4,080
4.00	365	5.00	825	6.00	1,410	7.00	2,170	9.00	4,320
4.10	405	5.10	875	6.10	1,475	7.20	2,350	9.20	4,560
4.20	445	5.20	930	6.20	1,540	7.40	2,540	9.40	4,820
4.30	490	5.30	985	6.30	1,610	7.60	2,740	9.60	5,080
4.40	535	5.40	1,040	6.40	1,680	7.80	2,940	9.80	5,340
4.50	580	5.50	1,100	6.50	1,755	8.00	3,160	10.00	5,600
4.60	625	5.60	1,160	6.60	1,830	8.20	3,380		
4.70	675	5.70	1,220	6.70	1,910	8.40	3,600		
4.80	725	5.80	1,280	6.80	1,990	8.60	3,840		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906 and is well defined below gage height 8 feet.

Monthly discharge of Truckee River at Vista, Nev., for 1906.

[Drainage area, 1,520 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	2,740	325	871	53,600	0.573	0.66
February	1,040	675	797	44,300	.524	.55
March	2,260	825	1,210	74,400	.796	.92
April	4,690	1,220	2,910	173,000	1.91	2.13
May	5,470	1,990	3,870	238,000	2.55	2.94
June	4,560	1,990	3,400	202,000	2.24	2.50
July	3,490	1,160	2,170	133,000	1.43	1.65
August	1,040	580	729	44,800	.480	.55
September	930	675	722	43,000	.475	.53
October	930	490	763	46,900	.502	.58
November	1,280	775	900	53,600	.592	.66
December	1,340	725	952	58,500	.626	.72
The year	5,470	325	1,610	1,170,000	1.06	14.39

NOTE.—The open-channel rating table was applied throughout the year; values for the winter months are liable to some error on account of ice.

LITTLE TRUCKEE RIVER AT PINE STATION, CAL.

Little Truckee River rises on the eastern slope of the Sierra Nevada Mountains, in northwestern Nevada County, Cal., flows north, then east, and then south, and unites with the Truckee at the town of Boca, Cal.

The station was established June 25, 1903. The cable station is located about one-fourth mile upstream from Bruhn's mill, known also as Pine station. The road which follows the Little Truckee north from Boca crosses the river at a ford about 150 feet below the cable and the same distance above the gage rod. Pine station, on the Boca and Loyalton Railroad, about one-fourth of a mile distant, is the nearest railroad point. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 92, where are given also references to publications that contain data for previous years.

Discharge measurements of Little Truckee River at Pine station, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet.*	*Sec.-feet.*
May 30	M. B. Kennedy	80	158	2.35	545
June 18	do	71	208	2.90	822
July 7	do	73	208	2.80	888
August 2	do	60	77	1.30	153

Daily gage height, in feet, of Little Truckee River at Pine station, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.30	1.68	1.05	1.92	3.06	2.45	2.74	1.32	0.78	0.70	0.82	0.90
2	1.23	1.55	1.10	1.82	3.62	2.50	2.78	1.28	.75	.70	.79	.94
3	1.28	1.60	1.12	1.73	3.55	2.64	2.85	1.22	.73	.68	.90	.92
4	1.30	1.48	1.10	1.68	3.59	3.04	2.86	1.18	.73	.68	1.32	.83
5	1.28	1.43	1.05	1.70	3.64	3.15	2.88	1.12	.73	.66	1.08	.78
6	1.28	1.45	1.05	1.85	3.64	2.92	2.82	1.10	.73	.68	.96	.92
7	1.23	1.43	1.06	2.09	3.66	2.72	2.78	1.05	.73	.68	.92	.92
8	1.18	1.40	1.12	2.30	3.62	2.82	2.75	1.04	.72	.68	.90	.88
9	1.30	1.50	1.15	2.52	3.59	3.19	2.65	1.03	.70	.65	.88	.92
10	1.30	1.43	1.22	2.49	3.56	3.49	2.50	1.12	.70	.65	.89	.98
11	1.30	1.48	1.30	2.39	3.69	3.44	2.26	1.06	.72	.65	.89	.68
12	1.30	1.40	1.40	2.40	3.42	3.69	2.26	1.02	.72	.66	.88	.90
13	1.38	1.33	2.39	2.49	3.25	3.36	2.34	.99	.72	.65	.88	1.29
14	1.50	1.30	1.20	2.60	3.21	3.19	2.32	.99	.74	.65	.88	1.32
15	1.60	1.20	1.18	2.90	3.09	3.09	2.18	.98	.75	.65	.88	1.26
16	1.83	1.39	1.30	3.02	2.80	3.45	2.19	.95	.74	.65	.90	1.24
17	2.10	1.35	1.30	3.02	2.66	3.36	2.00	.93	.73	.65	.89	1.38
18	2.98	1.28	1.30	3.14	2.74	3.01	1.94	.90	.70	.65	.88	1.24
19	3.33	1.20	1.30	3.29	2.89	3.31	1.86	.89	.70	.66	.75	1.16
20	3.20	1.33	1.19	3.42	2.94	3.21	1.80	.90	.70	.66	.88	1.05
21	3.03	1.40	1.28	3.55	2.84	3.23	1.74	.90	.69	.92	.82	1.10
22	2.83	1.38	1.48	3.62	2.81	3.25	1.55	.85	.68	.96	.83	1.12
23	2.75	1.20	1.53	3.42	2.64	3.21	1.56	.83	.68	1.00	.85	1.05
24	2.60	1.14	1.66	3.10	2.59	3.01	1.68	.82	.68	.95	.85	1.03
25	2.58	1.10	1.79	2.98	2.70	3.08	1.75	.80	.68	.94	.86	1.16
26	2.38	1.10	1.80	2.96	2.84	2.95	1.72	.80	.68	.90	.83	1.40
27	2.15	1.10	1.79	2.90	2.78	2.87	1.55	.79	.70	.86	.88	1.25
28	1.98	1.16	1.79	2.76	2.58	2.59	1.44	.78	.70	.82	.84	1.18
29	1.90	......	1.79	2.92	2.42	2.44	1.38	.78	.70	.78	.90	1.02
30	1.83	......	2.02	3.10	2.34	2.54	1.32	.80	.68	.78	.89	.99
31	1.80	......	2.06	......	2.43	......	1.30	.80	......	.70	..	1.21

Rating tables for Little Truckee River at Pine station, Cal.,

JANUARY 1, 1905, to APRIL 14, 1906.[a]

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	78	1.40	148	1.80	270	2.10	390	2.40	531
1.10	91	1.50	174	1.90	307	2.20	436	2.50	580
1.20	107	1.60	203	2.00	347	2.30	483	2.60	630
1.30	126	1.70	235						

APRIL 15 to DECEMBER 31, 1906.[b]

0.70	55	1.40	178	2.00	395	2.60	695	3.20	1,040
.80	67	1.50	206	2.10	440	2.70	750	3.30	1,100
.90	80	1.60	237	2.20	490	2.80	805	3.40	1,160
1.00	94	1.70	271	2.30	540	2.90	860	3.50	1,225
1.10	110	1.80	309	2.40	590	3.00	920	3.60	1,290
1.20	129	1.90	351	2.50	640	3.10	980	3.70	1,355
1.30	152								

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined below gage height 2.1 feet. The table has been extended beyond these limits.

[b] This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and the form of the 1905 curve and is not well defined.

Monthly discharge of Little Truckee River at Pine Station, Cal., for 1906.

[Drainage area, 166 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,020	104	359	22,100	2.16	2.49
February	229	91	141	7,830	.849	.88
March	373	84	159	9,780	.958	1.10
April	1,300	229	729	43,400	4.39	4.90
May	1,350	760	972	59,800	5.86	6.76
June	1,350	610	950	56,500	5.72	6.38
July	849	152	478	29,400	2.88	3.32
August	157	65	91.9	5,650	.554	.64
September	65	53	56.7	3,370	.342	.38
October	94	50	60.9	3,740	.367	.42
November	157	66	79.7	4,740	.480	.54
December	178	65	103	6,330	.608	.71
The year	1,350	50	348	253,000	2.10	28.52

NOTE.—The open-channel rating table was applied throughout the year; values for the winter months are liable to some errors on account of ice.

INDEPENDENCE CREEK BELOW INDEPENDENCE LAKE, CAL.

Independence Creek flows from the east end of Independence Lake northeastward into Little Truckee River.

The gaging station was established October 24, 1902. It is located about one-eighth of a mile below the dam at the lower end of Independence Lake, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 94, where are given also references to publications that contain data for previous years.

The following measurement was made July 31, 1906:

Width, 16 feet; area, 25.6 square feet; gage height, 2.65 feet; discharge, 25.3 second-feet.

Daily gage height, in feet, of Independence Creek below Independence Lake, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.96	1.95	2.58	2.58	2.80	1.52	3.45	2.62	2.25	1.95	2.20	2.28
2	1.95	1.90	2.50	2.52	2.92	1.95	3.52	2.60	2.25	1.95	2.22	2.25
3	1.90	1.90	2.50	2.48	3.00	2.20	3.62	2.62	2.20	1.95	2.30	2.25
4	1.90	1.90	2.50	2.40	3.50	2.80	3.62	2.58	2.20	1.95	2.40	2.25
5	1.90	1.90	2.48	2.38	3.12	3.40	3.72	2.68	2.20	1.95	2.45	2.25
6	1.90	1.90	2.40	2.32	3.18	3.48	3.68	2.65	2.20	1.95	2.42	2.25
7	1.88	1.90	2.38	2.30	3.22	3.42	3.75	2.62	2.20	1.95	2.42	2.25
8	1.85	1.90	2.35	2.30	3.00	3.50	3.80	2.50	2.18	1.95	2.40	2.30
9	1.90	1.90	2.32	2.30	3.50	3.50	3.72	2.62	2.10	1.92	2.40	2.35
10	1.85	1.85	2.30	2.38	3.50	3.45	3.50	2.60	2.10	1.90	2.40	2.42
11	1.85	1.85	2.25	2.40	3.50	3.58	3.40	2.65	2.10	1.90	2.40	2.40
12	1.92	1.85	2.60	2.38	3.42	3.60	3.42	2.50	2.10	1.90	2.40	3.80
13	2.48	1.85	2.72	2.35	3.40	3.60	3.48	2.48	2.10	1.90	2.38	3.50
14	2.78	1.88	2.75	2.35	3.40	3.60	3.50	2.48	2.05	1.90	2.55	2.95
15	2.88	2.25	2.80	2,35	3.35	3.60	3.48	2.42	2.05	1.90	2.38	2.90
16	2.98	2.25	2.78	2.40	3.30	3.60	3.45	2.42	2.05	1.90	2.42	2.85
17	3.08	2.00	2.70	2.45	3.25	3.30	3.42	2.45	2.05	1.85	2.38	2.80
18	3.35	2.35	2.62	2.50	3.18	3.45	3.45	2.42	2.05	1.85	2.35	2.52
19	3.30	2.10	2.52	2.58	3.15	3.62	3.42	2.40	2.05	1.85	2.35	2.30
20	3.20	2.15	2.50	2.60	3.15	3.50	3.28	2.45	2.02	2.48	2.35	2.30
21	3.08	2.40	2.50	2.72	3.15	3.60	2.68	2.42	2.00	3.50	2.35	2.30
22	2.98	2.65	2.50	2.82	3.15	3.68	2.75	2.42	2.00	2.98	2.35	2.30
23	2.82	2.70	2.52	2.88	3.15	3.75	3.22	2.32	2.00	2.92	2.35	2.35
24	2.78	2.62	2.52	2.90	3.12	3.82	3.52	2.30	2.00	2.82	2.32	2.38
25	2.60	2.58	2.55	2.85	3.18	3.85	3.48	2.30	2.00	2.75	2.30	2.40
26	2.58	2.50	2.52	2.80	3.20	3.78	2.90	2.30	2.00	2.72	2.30	2.45
27	2.52	2.52	2.48	2.80	3.28	3.75	2.91	2.30	2.00	2.62	2.30	2.50
28	2.42	2.60	2.42	2.80	3.25	3.72	2.60	2.25	2.00	2.15	2.30	2.50
29	2.32	....	2.38	2.75	3.18	3.60	2.58	2.25	2.00	2.20	2.30	2.50
30	2.12	....	2.38	2.75	2.15	3.48	2.68	2.25	1.95	2.20	2.30	2.40
31	1.95	....	2.52	....	2.15	....	2.65	2.25	....	2.20	....	2.18

WALKER RIVER BASIN.

DESCRIPTION OF BASIN.

Walker River is formed by two branches—East and West forks—which rise on the eastern slopes of the Sierra Nevada, in Mono County, Cal., flow in a general northerly direction, and unite in Lyon County, Nev. From the point of junction the main stream flows northward through Mason Valley, at the upper end of which it turns to the east and southeast and discharges into the north end of Walker Lake.

WEST FORK OF WALKER RIVER NEAR COLEVILLE, CAL.

This station was established October 5, 1902. The cable is located about 1 mile east of the point where the main road from Topaz to Bridgeport crosses Lost Canyon Creek and is 600 feet from the road. The gage is about one-half mile above the cable. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 99, where are given also references to publications that contain data for previous years.

Discharge measurements of West Fork of Walker River near Coleville, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11	M. H. Kennedy	60	259	4.10	1,790
May 16	do	60	195	3.50	1,220
June 8	do	53	179	3.30	960
June 13	do	60	283	4.70	2,150
July 19	do	60	253	4.15	1,890
August 19	do	49	135	3.00	627

Daily gage height, in feet, of West Fork of Walker River near Coleville, Cal., in 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.1	1.3	1.4	1.6	2.9	3.0	5.1	3.3	2.2	1.5	1.5	1.3
2	1.1	1.3	1.6	1.6	3.1	3.2	5.3	3.25	2.1	1.5	1.4	1.3
3	0.9	1.3	1.4	1.6	3.1	3.4	5.45	3.1	2.1	1.5	1.4	1.3
4	1.1	1.3	1.3	1.6	3.5	3.6	5.45	3.0	2.1	1.4	1.4	1.3
5	1.1	1.3	1.3	1.6	3.8	3.7	5.4	3.0	2.0	1.4	1.5	1.3
6	1.1	1.3	1.3	1.5	3.9	3.5	5.35	3.0	2.0	1.4	1.5	1.3
7	1.1	1.3	1.3	1.5	4.0	3.3	5.25	3.1	2.1	1.4	1.5	1.4
8	1.1	1.2	1.3	1.6	4.0	3.5	5.35	3.0	2.1	1.4	1.4	1.4
9	1.1	1.2	1.3	1.7	4.1	3.5	4.9	3.0	2.0	1.4	1.4	1.4
10	1.1	1.2	1.3	2.0	4.1	4.35	4.6	2.9	2.0	1.4	1.4	1.4
11	1.1	1.2	1.4	1.9	4.1	4.8	4.7	2.9	2.0	1.4	1.4	1.4
12	1.1	1.2	1.5	1.9	3.9	5.2	4.45	2.9	2.0	1.4	1.4	1.4
13	1.2	1.2	1.4	2.0	3.9	5.2	4.45	2.9	2.0	1.4	1.4	1.4
14	1.2	1.2	1.4	2.1	3.9	4.55	5.0	2.9	2.0	1.4	1.4	1.4
15	1.2	1.2	1.3	2.2	3.7	4.8	4.6	2.8	2.2	1.4	1.4	1.4
16	1.2	1.2	1.4	2.3	3.6	5.35	4.3	2.7	2.1	1.4	1.4	1.4
17	1.2	1.2	1.4	2.5	3.5	4.9	4.45	2.6	2.0	1.4	1.4	1.4
18	1.5	1.2	1.4	2.6	3.6	4.75	4.15	2.6	1.9	1.4	1.4	1.4
19	1.5	1.2	1.4	2.7	3.8	5.15	4.0	3.0	1.8	1.4	1.3	1.3
20	1.4	1.2	1.4	2.9	3.8	5.25	4.15	2.8	1.7	1.4	1.3	1.3
21	1.3	1.2	1.5	2.9	3.8	5.15	4.1	2.6	1.7	1.4	1.3	1.3
22	1.3	1.3	1.5	3.2	3.7	5.15	4.15	2.5	1.7	1.3	1.3	1.3
23	1.3	1.3	1.5	3.1	3.5	4.9	4.4	2.4	1.7	1.4	1.3	1.3
24	1.3	1.2	1.6	3.1	3.5	4.75	4.35	2.4	1.6	1.4	1.3	1.3
25	1.2	1.3	1.6	3.0	3.5	5.15	4.35	2.2	1.5	1.4	1.4	1.4
26	1.2	1.3	1.6	2.8	3.3	4.95	4.3	2.2	1.5	1.4	1.3	1.4
27	1.2	1.3	1.5	2.9	3.3	4.45	4.25	2.2	1.5	1.4	1.3	1.5
28	1.2	1.3	1.6	2.9	3.2	4.25	3.85	2.2	1.5	1.4	1.3	1.5
29	1.3	....	1.6	2.9	3.1	4.2	3.6	2.2	1.5	1.3	1.3	1.4
30	1.3	....	1.7	2.7	3.0	4.25	3.55	2.2	1.5	1.4	1.3	1.4
31	1.3	....	1.7	....	3.0	....	3.4	2.1	....	1.4	....	1.4

Rating table for West Fork of Walker River near Coleville, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	50	1.70	145	2.50	385	3.30	870	4.20	1,760
1.00	58	1.80	165	2.60	425	3.40	955	4.40	1,990
1.10	67	1.90	190	2.70	470	3.50	1,040	4.60	2,230
1.20	77	2.00	220	2.80	520	3.60	1,130	4.80	2,470
1.30	87	2.10	250	2.90	580	3.70	1,220	5.00	2,710
1.40	98	2.20	280	3.00	645	3.80	1,320	5.20	2,970
1.50	110	2.30	315	3.10	715	3.90	1,430	5.40	3,230
1.60	125	2.40	350	3.20	790	4.00	1,540		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1906 and is fairly well defined.

Monthly discharge of West Fork of Walker River near Coleville, Cal., for 1906.

[Drainage area, 306 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	110	50	77.6	4,770	0.254	0.29
February	87	77	81.6	4,530	.267	.28
March	145	87	105	6,460	.343	.40
April	790	110	360	21,400	1.18	1.32
May	1,650	580	1,140	70,100	3.73	4.30
June	3,160	645	2,050	122,000	6.70	7.48
July	3,300	955	2,180	134,000	7.12	8.21
August	870	250	506	31,100	1.65	1.90
September	280	110	192	11,400	.627	.70
October	110	87	98.5	6,060	.322	.37
November	110	87	95.6	5,690	.312	.35
December	110	87	94.5	5,810	.309	.36
The year	3,300	50	582	423,000	1.90	25.96

NOTE.—The open-channel rating table was applied throughout the year; values for winter months are liable to error on account of ice.

EAST FORK OF WALKER RIVER NEAR YERINGTON, NEV.

This station was established October 6, 1902. It is located at Ross Ranch, about 10 miles southeast of Yerington, Nev., just above the point where the road crosses the river. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 101, where are given also references to publications that contain data for previous years.

Discharge measurements of East Fork of Walker River near Yerington, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	M. B. Kennedy	75	196	3.75	592
June 9	do	74	117	3.03	347
June 12	do	76	164	3.65	582
July 20	do	80	214	5.00	1,070
August 29	do	65	113	3.30	342

Daily gage height, in feet, of East Fork of Walker River near Yerington, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	2.1	2.4	2.7	2.9	2.9	4.6	4.4	3.1	2.4	2.3	2.6
2	1.9	2.1	2.4	2.6	3.0	2.8	4.5	4.25	3.1	2.4	2.3	2.6
3	1.9	2.1	2.4	2.5	3.1	2.8	4.6	4.1	3.1	2.4	2.3	2.6
4	1.9	2.1	2.4	2.4	3.1	2.8	4.7	4.0	3.0	2.4	2.3	2.6
5	1.9	2.1	2.4	2.4	3.2	2.9	4.85	3.9	3.0	2.5	2.3	2.7
6	1.9	2.1	2.4	2.4	3.4	2.9	5.0	3.8	2.9	2.5	2.3	2.7
7	1.9	2.1	2.4	2.4	3.5	3.0	5.1	3.9	2.9	2.5	2.3	2.7
8	1.9	2.1	2.4	2.4	3.5	3.1	5.4	3.9	2.9	2.5	2.3	2.7
9	1.9	2.1	2.4	2.4	3.6	3.2	5.1	3.9	2.9	2.5	2.3	2.7
10	1.9	2.1	2.4	2.5	3.7	3.3	5.1	3.9	2.8	2.5	2.3	2.8
11	1.9	2.2	2.4	2.7	3.9	3.5	5.0	3.9	2.8	2.6	2.3	2.8
12	1.9	2.2	2.4	2.6	4.0	3.6	4.95	3.9	2.8	2.6	2.3	2.8
13	2.0	2.1	2.8	2.6	3.9	3.85	4.85	3.7	2.8	2.6	2.4	2.8
14	2.0	2.1	2.8	2.5	3.6	4.0	4.8	3.7	2.8	2.6	2.4	2.8
15	2.0	2.1	2.4	2.5	3.5	4.1	4.75	3.6	2.8	2.6	2.4	2.8
16	2.0	2.1	2.4	2.5	3.4	4.2	4.7	3.6	2.8	2.5	2.4	2.8
17	2.0	2.1	2.4	2.6	3.3	4.3	4.75	3.6	2.7	2.5	2.4	2.9
18	2.25	2.2	2.3	2.6	3.2	4.5	4.7	3.75	2.7	2.5	2.4	2.9
19	2.9	2.3	2.3	2.6	3.2	4.7	4.6	3.8	2.7	2.5	2.4	2.9
20	3.6	2.3	2.3	2.6	3.2	4.7	4.6	4.0	2.7	2.5	2.4	2.9
21	3.1	2.5	2.4	2.7	3.3	4.7	4.6	4.0	2.6	2.5	2.4	2.9
22	2.7	2.45	2.5	2.8	3.3	4.8	4.6	3.8	2.6	2.5	2.4	2.9
23	2.6	2.4	2.6	2.8	3.3	4.8	4.9	3.7	2.6	2.5	2.4	2.9
24	2.5	2.4	2.85	2.8	3.2	4.8	5.0	3.6	2.5	2.5	2.4	2.9
25	2.4	2.4	3.1	2.8	3.2	4.8	4.8	3.5	2.5	2.4	2.5	2.9
26	2.2	2.4	3.1	2.8	3.3	4.8	4.9	3.5	2.5	2.4	2.5	2.9
27	2.2	2.4	3.0	2.8	3.3	4.8	4.95	3.4	2.5	2.4	2.5	2.9
28	2.2	2.4	2.7	2.9	3.3	4.95	4.85	3.3	2.4	2.4	2.5	2.9
29	2.2	......	2.7	2.9	3.2	4.9	4.75	3.3	2.4	2.4	2.6	2.9
30	2.2	......	2.8	2.9	3.1	4.65	4.65	3.2	2.4	2.4	2.6	2.9
31	2.2	......	2.8	......	3.0	......	4.5	3.2	......	2.4	......	2.9

NOTE.—The river was frozen over January 1 to 12.

Rating tables for East Fork of Walker River near Yerington, Nev.

JANUARY 1 TO JULY 10, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	54	2.60	220	3.30	439	4.00	692	4.70	955
2.00	75	2.70	248	3.40	474	4.10	729	4.80	993
2.10	97	2.80	277	3.50	510	4.20	766	4.90	1,031
2.20	120	2.90	308	3.60	546	4.30	803	5.00	1,070
2.30	144	3.00	340	3.70	582	4.40	841	5.20	1,148
4.40	168	3.10	372	3.80	618	4.50	879	5.40	1,226
2.50	193	3.20	405	3.90	655	4.60	917		

JULY 11 TO DECEMBER 31, 1906.[b]

2.30	56	2.90	211	3.50	420	4.10	665	4.70	935
2.40	78	3.00	242	3.60	460	4.20	710	4.80	980
2.50	102	3.10	274	3.70	500	4.30	755	4.90	1,025
2.60	127	3.20	308	3.80	540	4.40	800	5.00	1,070
2.70	154	3.30	344	3.90	580	4.50	845		
2.80	182	3.40	381	4.00	620	4.60	890		

[a] This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is fairly well defined above gage height 2.5 feet; below this it is only approximate.

[b] This table is applicable only for open-channel conditions. It is based on 2 discharge measurements made during 1906 and is not well defined.

Monthly discharge of East Fork of Walker River near Yerington, Nev., for 1906.

[Drainage area, 1,100 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	546	54	127	7,810	0.115	0.13
February	193	97	124	6,890	.113	.12
March	372	144	210	12,900	.191	.22
April	308	168	228	13,600	.207	.23
May	692	308	457	28,100	.415	.48
June	1,050	277	690	41,100	.627	.70
July	1,230	845	987	60,700	.897	1.03
August	800	308	520	32,000	.473	.55
September	274	78	169	10,100	.154	.17
October	127	78	95.0	5,840	.086	.10
November	127	56	75.7	4,500	.069	.08
December	211	127	184	11,300	.167	.19
The year	1,230	54	322	235,000	.293	4.00

NOTE.—The open-channel rating table was applied throughout the year; values for the winter are liable to error on account of ice.

WALKER RIVER NEAR WABUSKA, NEV.

This station was established July 22, 1902, and equipped December 12, 1902. It is located about 300 feet above the Carson and Colorado Railroad bridge, near the section house at Clever station, and about 2½ miles east of Wabuska. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 103, where are given also references to publications that contain data for previous years.

Discharge measurements of Walker River near Wabuska, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 14	M. B. Kennedy	70	408	4.20	1,470
June 11	do	75	272	3.30	921
July 21	do	178	600	4.50	2,310
August 27	do	70	174	1.60	410
September 14	C. L. Smith	50	75	.80	128

Daily gage height, in feet, of Walker River near Wabuska, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	1.50	1.52	1.72	2.40	2.75	5.05	3.92	1.12	0.80	1.65	1.95
2	1.00	1.42	1.55	1.80	2.35	2.65	4.90	3.70	1.10	.80	1.70	1.90
3	1.05	1.40	1.50	1.80	2.42	2.58	5.00	3.35	1.10	.80	1.70	1.75
4	1.05	1.40	1.40	1.72	2.60	2.55	5.15	3.18	1.08	.90	1.70	1.70
5	1.05	1.40	1.32	1.65	2.78	2.70	5.35	2.95	1.00	1.00	1.70	1.90
6	1.05	1.40	1.22	1.52	3.00	3.00	5.55	2.90	1.00	1.20	1.75	1.90
7	1.05	1.40	1.20	1.38	3.40	3.18	5.70	2.75	.92	1.38	1.80	1.90
8	1.05	1.40	1.28	1.30	3.75	3.05	5.65	2.70	.82	1.40	1.80	2.05
9	1.05	1.40	1.30	1.32	3.80	2.92	5.80	2.70	.72	1.40	1.80	2.22
10	1.05	1.40	1.18	1.38	3.95	2.92	5.88	2.58	.68	1.40	1.80	2.32
11	1.05	1.40	1.08	1.40	4.20	3.38	5.85	2.55	.65	1.48	1.88	2.40
12	1.08	1.38	1.05	1.45	4.42	3.85	5.60	2.55	.65	1.50	1.90	2.40
13	1.15	1.20	1.38	1.55	4.32	4.30	5.30	2.50	.65	1.50	1.80	2.45
14	1.15	1.15	1.62	1.60	4.15	4.70	5.28	2.50	.70	1.48	1.80	2.35
15	1.55	1.18	1.52	1.60	4.05	5.05	5.40	2.50	.70	1.45	1.80	2.30
16	1.75	1.20	1.48	1.60	4.05	5.10	5.45	2.15	.70	1.45	1.80	2.42
17	1.85	1.30	1.40	1.70	3.88	4.95	5.22	2.00	.70	1.45	1.80	2.38
18	1.85	1.30	1.35	1.80	3.55	5.15	5.00	1.98	.70	1.45	1.80	2.30
19	1.88	1.25	1.30	1.90	3.45	5.22	4.95	1.95	.75	1.50	1.80	2.28
20	2.15	1.25	1.25	2.00	3.45	5.35	4.75	2.05	.80	1.50	1.80	2.25
21	2.30	1.35	1.20	2.05	3.65	5.38	4.50	2.10	.85	1.55	1.80	2.18
22	2.20	1.60	1.12	2.32	3.75	5.40	4.38	2.05	.85	1.55	1.80	2.10
23	2.02	1.70	1.10	2.40	3.75	5.40	4.35	1.95	.85	1.60	1.80	2.10
24	1.88	1.70	1.15	2.55	3.60	5.48	4.72	1.90	.85	1.60	1.80	2.10
25	1.80	1.65	1.58	2.65	3.40	5.50	5.22	1.75	.85	1.60	1.80	2.08
26	1.80	1.55	1.98	2.55	3.18	5.40	5.32	1.62	.85	1.60	1.90	2.00
27	1.72	1.50	2.05	2.45	3.10	5.45	5.25	1.50	.85	1.70	1.98	2.00
28	1.70	1.50	1.90	2.45	3.00	5.40	5.22	1.42	.85	1.70	2.08	2.25
29	1.62	....	1.75	2.45	3.00	5.32	5.18	1.32	.80	1.68	2.02	2.40
30	1.55	....	1.70	2.40	3.00	5.20	4.68	1.30	.80	1.65	1.98	2.42
31	1.50	....	1.70	....	2.95	....	4.10	1.22	....	1.65	....	2.32

NOTE.—Ice conditions unknown. No discharges have been computed on account of the constant changes in channel and the small number of measurements.

CARSON RIVER BASIN.

DESCRIPTION OF BASIN.

Carson River has its sources on the eastern slopes of the Sierra Nevada in Alpine County, Cal. Flowing northward into Nevada, East and West forks unite near Genoa, in the upper Carson Valley. At Empire, 3 miles east of the city of Carson, the river turns to the northeast and enters a deep canyon, through which it flows for several miles, emerging into a second, smaller valley a short distance above the town of Dayton. After leaving this valley it passes through two shorter canyons and one rather large valley before entering lower Carson Valley, or Carson Sink Valley, as it is also known, and discharging its waters into Carson Sink.

WEST FORK OF CARSON RIVER NEAR WOODFORDS, CAL.

West Fork of Carson River rises in Alpine County, Cal., flows in a general northerly direction, and unites with east Fork in Douglas County, Nev.

The gaging station was established October 18, 1900. It is located about three-fourths of a mile above the post-office at Woodfords, Cal., and 200 feet from the main road between Woodfords and Blue Lakes. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 106, where are given also references to publications that contain data for previous years.

Discharge measurements of West Fork of Carson River near Woodfords, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 9	M. B. Kennedy	32	180	6.70	1,520
May 18	do	38	130	5.10	695
June 5	do	40	154	5.20	764
June 16	do	37	157	5.60	899
July 17	do	30	105	4.10	373
August 16	do	30	60	3.05	108

Daily gage height, in feet, of West Fork of Carson River near Woodfords, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	2.85	2.5	2.85	5.7	4.4	4.6	3.4		2.4	2.7	2.0
2	2.5	2.8	2.55	2.8	5.85	4.6	4.7	3.3	2.9	2.4	2.7	2.1
3	2.55	2.75	2.55	2.8	6.0	4.8	4.8	3.3	2.9	2.4	2.95	2.1
4	2.55	2.6	2.5	2.75	6.1	5.0	4.7	3.3	2.85	2.4	3.1	2.15
5	2.4	2.6	2.55	2.6	6.4	5.0	4.7	3.25	2.8	2.4	3.3	2.1
6	2.4	2.6	2.6	2.55	6.45	4.7	4.7	3.3	2.7	2.35	3.0	2.1
7	2.4	2.6	2.65	2.5	6.5	4.9	4.7	3.3	2.6	2.6	2.9	2.0
8	2.3	2.55	2.7	2.6	6.7	4.8	4.6	3.25	2.55	2.55	2.9	2.5
9	2.35	2.5	2.75	2.6	6.8	4.8	4.5	3.9	2.5	2.5	2.85	2.6
10	2.5	2.4	2.6	2.7	6.8	5.2	4.4	3.5	2.5	2.5	2.8	2.7
11	2.6	2.5	2.55	2.7	6.4	5.5	4.3	3.4	2.4	2.45	2.9	2.7
12	2.75	2.55	2.5	2.75	6.35	5.8	4.2	3.4	2.4	2.4	2.9	2.6
13	2.85	2.6	2.45	2.8		5.7	4.2	3.4	2.3	2.4	3.1	2.7
14	2.9	2.7	2.4	2.9		5.8	4.1	3.35	2.4	2.45	3.2	2.65
15	2.9	2.75	2.4	2.95		5.8	4.0		2.2	2.4	3.0	2.6
16	3.0	2.75	2.45	3.0		5.7	4.0		2.2	2.4	3.0	2.6
17	3.1	2.8	2.5	3.25	5.1	5.6	3.8		2.2	2.45	2.9	2.55
18	3.2	2.8	2.5	3.3		5.5	3.7	3.4	2.2	2.4	2.8	2.5
19	3.1	2.85	2.55	3.5	5.0	5.3	3.65	3.4	2.3	2.5	2.6	2.55
20	3.0	2.8	2.6	3.7	4.9	5.0	3.5	3.3	2.2	2.5	2.6	2.6
21	3.0	2.8	2.65	3.85	4.9	5.0	3.4	3.35	2.2	2.6	2.55	2.65
22	2.9	2.75	2.7	4.1	4.95	5.0	3.3	3.4	2.3	2.6	2.55	2.7
23	2.65	2.7	2.8	4.2	5.0	4.9	3.35	3.35	2.4	2.6	2.55	2.7
24	2.4	2.6	2.8	4.3	5.1	4.9	3.2	3.35	2.5	2.65	2.5	2.7
25	2.5	2.55	2.8	4.4	4.95	4.8	3.2	3.3	2.5	2.65	2.45	2.75
26	2.6	2.5	2.9	4.6	4.9	4.7	4.3	3.3	2.4	2.6	2.4	2.8
27	2.75	2.5	2.95	4.85		4.8	3.6	3.3	2.35	2.65	2.4	2.8
28	2.8	2.5	2.95	5.1		4.8	3.55	3.25	2.35	2.6	2.3	2.85
29	2.8		3.0	5.3		4.7	3.4	3.2	2.30	2.55	2.2	2.9
30	2.85		3.0	5.5		4.8	3.3	3.2	2.35	2.6	2.15	2.85
31	2.85		2.9				3.3			2.65		2.85

Rating table for West Fork of Carson River near Woodfords, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	22	2.90	90	3.80	251	4.70	535	6.20	1,220
2.10	26	3.00	102	3.90	277	4.80	570	6.40	1,330
2.20	31	3.10	115	4.00	305	4.90	610	6.60	1,450
2.30	37	3.20	129	4.10	335	5.00	650	6.80	1,570
2.40	44	3.30	145	4.20	365	5.20	730		
2.50	52	3.40	163	4.30	395	5.40	820		
2.60	60	3.50	182	4.40	430	5.60	910		
2.70	69	3.60	203	4.50	465	5.80	1,010		
2.80	79	3.70	226	4.60	500	6.00	1,110		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1906, and is fairly well defined.

Monthly discharge of West Fork of Carson River near Woodfords, Cal., for 1906.

[Drainage area, 70 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	129	37	72.3	4,450	1.03	1.19
February	84	44	65.3	3,630	.933	.97
March	102	44	66.5	4,090	.950	1.10
April	865	52	236	14,000	3.37	3.76
May	1,570	460	925	56,900	13.20	15.22
June	1,010	430	690	41,100	9.86	11.00
July	570	129	324	19,900	4.63	5.34
August	277	116	154	9,470	2.20	2.54
September	103	31	50.4	3,000	.720	.80
October	65	44	52.8	3,250	.754	.87
November	145	28	76.9	4,580	1.10	1.23
December	90	22	58.4	3,590	.834	.96
The year	1,570	22	231	168,000	3.30	44.98

NOTE.—Discharges have been interpolated on days when gage was not read. The open-channel rating table was applied throughout the year; values for winter months are liable to some error on account of ice.

EAST FORK OF CARSON RIVER NEAR GARDNERVILLE, NEV.

East Fork of Carson River rises in southeastern Alpine County, flows in a general northerly direction, and joins West Fork in Douglas County, Nev.

The gaging station was established October 17, 1900. It is located about 5 miles southeast of Gardnerville and one-half mile southwest of Rodenbah's ranch. It is within one-half mile of the main traveled road between Carson, Nev., and Bridgeport, Cal., and is about 400 feet above a bridge across the river. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 108, where are given also references to publications that contain data for previous years.

Discharge measurements of East Fork of Carson River near Gardnerville, Nev., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 10	M. B. Kennedy	103	490	[a]5.60	2,820
May 17	do	92	352	[a]4.75	1,610
June 6	do	92	343	[a]4.60	1,470
June 15	do	92	457	[b]6.45	2,400
July 18	do	84	348	[b]5.65	1,650
August 17	do	84	194	[b]4.05	415
September 6	C. L. Smith	85	165	[b]3.90	182

[a] At new gage established October 8, 1905. [b] At old gage used prior to October 8, 1905.

Daily gage height, in feet, of East Fork of Carson River near Gardnerville, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.98	2.75	2.72	3.10	4.20	4.60	5.40	4.00	2.75	2.50	3.58	2.54
2	1.98	2.72	2.72	3.10	4.40	4.70	5.80	3.90	2.75	2.50	3.57	2.54
3	1.98	2.72	2.71	3.20	4.70	4.70	5.50	3.80	2.75	2.50	3.55	2.54
4	1.98	2.72	2.71	3.25	5.00	4.70	5.30	3.70	2.75	2.50	3.54	2.54
5	1.98	2.72	2.70	3.28	5.10	4.75	5.20	3.65	2.70	2.50	3.59	2.54
6	1.98	2.72	2.70	3.30	5.90	4.80	5.00	3.60	2.70	2.50	3.60	2.54
7	1.99	2.72	2.70	3.30	5.80	4.80	5.00	3.50	2.70	2.55	3.58	2.54
8	2.00	2.72	2.70	3.30	5.80	4.80	4.80	3.50	2.70	2.58	3.56	2.54
9	2.00	2.72	2.71	3.40	5.80	4.90	4.60	3.45	2.60	2.60	3.53	2.54
10	2.05	2.72	2.73	3.45	6.00	5.00	4.60	3.45	2.60	2.60	3.50	2.54
11	2.05	2.74	2.73	3.46	6.00	5.00	4.50	3.44	2.60	2.61	3.50	2.54
12	2.05	2.74	2.74	3.47	5.90	5.40	4.80	3.44	2.60	2.63	3.58	2.54
13	2.05	2.74	2.75	3.48	5.80	5.50	5.10	3.43	2.60	2.65	2.58	2.55
14	......	2.73	2.75	3.49	5.60	5.80	4.70	3.43	2.59	2.67	2.58	2.56
15	......	2.73	2.74	4.00	5.50	5.90	4.60	3.43	2.59	2.69	2.57	2.56
16	......	2.73	2.74	4.00	5.50	5.90	4.60	3.42	2.58	3.00	2.56	2.54
17	......	2.74	2.72	4.10	5.40	6.00	4.50	3.15	2.58	3.10	2.56	2.54
18	......	2.74	2.75	4.20	5.40	6.10	4.50	3.15	2.58	3.20	2.56	2.53
19	......	2.74	2.75	4.20	5.30	6.40	4.40	3.00	2.58	3.40	2.56	2.53
20	......	2.74	2.77	4.40	4.80	6.40	4.40	3.00	2.56	3.50	2.55	2.53
21	2.82	2.74	2.77	4.50	4.80	6.00	4.37	2.90	2.56	3.50	2.55	2.53
22	2.80	2.73	2.79	4.60	4.60	6.20	4.35	2.90	2.56	3.70	2.55	2.53
23	2.70	2.73	2.80	4.40	4.60	6.10	4.35	2.90	2.54	3.70	2.55	2.53
24	2.70	2.74	2.81	4.30	4.40	5.50	4.43	2.90	2.54	3.70	2.55	2.53
25	2.80	2.73	2.81	4.25	4.30	6.00	4.60	2.80	2.54	3.70	2.54	2.53
26	2.80	2.72	2.80	4.15	4.30	5.60	4.90	2.80	2.53	3.65	2.54	2.53
27	2.80	2.72	2.80	3.98	4.40	5.50	4.80	2.80	2.53	3.64	2.54	2.53
28	2.75	2.72	2.80	3.96	4.50	5.20	4.70	2.70	2.51	3.63	2.54	2.53
29	2.75	......	2.79	3.94	4.50	5.20	4.60	2.70	2.50	3.62	2.54	2.54
30	2.75	......	2.79	4.00	4.55	5.40	4.30	2.70	2.50	3.61	2.54	2.54
31	2.75	......	2.78	......	4.58	......	4.00	2.70	......	3.59	......	2.54

NOTE.—Ice conditions not known. Gage heights refer to new gage established October 8, 1905.

CARSON RIVER NEAR EMPIRE, NEV.

This station was established October 21, 1900. It is located about three-fourths of a mile east of Brunswick Mill and 2½ miles east of Empire, Nev. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 111, where are given also references to publications that contain data for previous years.

Discharge measurements of Carson River near Empire, Nev., by M. B. Kennedy in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	90	421	6.20	2,210
May 21	90	412	5.90	2,030
June 4	88	383	5.40	1,660
June 17	89	459	6.50	2,400
July 16	90	450	5.90	2,160
July 27	88	367	5.20	1,530
August 14	78	224	3.60	475

Daily gage height, in feet, of Carson River near Empire, Nev., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.9	3.1	4.0	4.7	4.7	5.0	4.3	2.4	2.2	2.8	2.6
2	2.7	2.0	3.0	3.8	4.8	4.8	6.0	4.1	2.5	2.2	2.8	2.7
3	2.5	2.9	3.0	3.7	5.0	4.0	6.3	4.0	2.4	2.2	2.8	2.9
4	2.4	2.9	3.0	3.5	5.4	5.1	6.4	3.9	2.3	2.4	2.8	2.9
5	2.4	2.0	3.0	3.4	5.7	5.5	6.5	3.8	2.2	2.5	3.2	2.9
6	2.4	2.0	3.0	3.4	5.0	5.0	6.6	3.6	2.2	2.5	3.2	2.9
7	2.4	2.0	2.9	3.5	6.1	5.7	6.6	3.5	2.1	2.5	3.2	3.0
8	2.4	2.0	2.9	3.6	6.3	5.2	6.5	3.4	2.0	2.5	3.1	3.3
9	2.4	2.9	3.0	3.8	6.4	5.3	6.4	3.6	2.1	2.6	3.1	3.7
10	2.5	2.9	3.0	4.0	6.5	5.7	6.4	3.6	2.1	2.6	3.1	3.6
11	2.6	2.9	3.0	4.2	6.5	6.1	6.2	3.7	1.9	2.6	3.0	3.8
12	2.8	2.9	3.3	4.1	6.7	6.5	6.0	3.8	1.0	2.6	3.0	4.6
13	3.2	2.0	4.1	4.0	6.5	6.0	5.0	3.7	2.1	2.6	3.0	4.0
14	4.9	2.8	3.7	4.1	6.3	7.2	6.0	3.6	2.2	2.6	3.0	3.5
15	4.0	2.9	3.6	4.1	6.2	7.0	5.9	3.5	2.2	2.7	3.0	3.4
16	3.4	3.2	3.5	4.3	6.2	6.6	5.8	3.3	2.3	2.7	3.0	3.3
17	4.5	3.1	3.5	4.5	6.0	6.6	5.6	3.3	2.5	2.6	3.0	3.3
18	4.9	3.0	3.3	4.6	5.7	6.0	5.5	3.2	2.5	2.6	3.0	3.2
19	5.5	3.1	3.2	4.7	5.7	6.8	5.3	3.2	2.5	2.6	3.0	3.2
20	5.9	3.3	3.1	4.8	6.0	6.5	5.0	3.1	2.4	2.7	3.0	3.2
21	4.0	3.4	3.3	4.0	6.1	6.7	4.0	3.0	2.4	2.7	2.9	3.2
22	3.6	3.5	3.4	5.0	6.0	6.7	4.9	3.0	2.4	2.7	2.8	3.2
23	3.4	3.4	3.6	5.2	5.9	6.7	4.8	2.9	2.3	2.7	2.9	3.2
24	3.3	3.3	3.7	5.4	5.6	6.7	5.0	2.0	2.3	2.7	2.9	3.2
25	3.2	3.2	4.5	5.0	5.4	6.5	5.0	2.9	2.2	2.7	2.8	3.3
26	3.2	3.1	4.4	4.6	5.3	6.5	5.4	2.0	2.2	2.7	2.8	3.4
27	3.0	3.1	4.0	4.5	5.3	6.5	5.3	2.8	2.2	2.7	2.8	3.8
28	3.0	3.1	3.8	4.6	5.3	6.3	5.1	2.7	2.2	2.7	2.7	4.0
29	3.0	......	3.6	4.7	5.1	6.1	4.0	2.7	2.2	2.7	2.6	3.9
30	2.9	......	3.7	4.7	5.0	5.9	4.7	2.5	2.2	2.7	2.6	3.8
31	2.9	......	3.7	......	4.9	......	4.5	2.4	......	2.7	......	3.7

Rating table for Carson River near Empire, Nev., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	51	2.80	223	3.70	554	4.60	1,090	5.80	1,970
2.00	63	2.90	251	3.80	603	4.70	1,160	6.00	2,120
2.10	77	3.00	281	3.90	654	4.80	1,230	6.20	2,270
2.20	93	3.10	313	4.00	708	4.90	1,300	6.40	2,420
2.30	110	3.20	347	4.10	765	5.00	1,370	6.60	2,570
2.40	129	3.30	384	4.20	825	5.20	1,520	6.80	2,720
2.50	150	3.40	423	4.30	890	5.40	1,670	7.00	2,870
2.60	173	3.50	464	4.40	955	5.60	1,820	7.20	3,020
2.70	197	3.60	508	4.50	1,020				

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1902–1906 and is well defined below gage heights 5.4 feet.

Monthly discharge of Carson River near Empire, Nev., for 1906.

[Drainage area, 988 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	2,040	129	477	29,300	0.483	0.56
February	464	223	298	16,600	.302	.31
March	1,020	251	452	27,800	.457	.53
April	1,670	423	914	54,400	.925	1.03
May	2,640	1,160	1,940	119,000	1.96	2.26
June	3,020	1,160	2,240	133,000	2.27	2.53
July	2,570	1,020	1,860	114,000	1.88	2.17
August	890	129	418	25,700	.423	.49
September	150	51	101	6,010	.102	.11
October	197	93	172	10,600	.174	.20
November	347	173	262	15,600	.265	.30
December	1,090	173	436	26,800	.441	.51
The year	3,020	51	798	579,000	.807	11.00

NOTE.—The open-channel rating table was applied throughout the year; values for winter months may be somewhat in error on account of ice.

OWENS RIVER DRAINAGE BASIN.

Owens River has its source in the Sierra Nevada, in eastern California, and flows southeastward, parallel with this range, finally discharging its waters into Owens Lake. Its basin has a length from north to south of approximately 150 miles and a width of from 20 to 25 miles; it lies between the Sierra Nevada on the west and the White Mountains on the east. Practically the entire flow is derived from the Sierra Nevada, as it drains the eastern slope of this range from Mount Lyell, on the north, to a point some distance below Mount Whitney, on the south.

The results of data collected in Owens River Valley in 1906 are contained in Water-Supply Paper No. 213, which presents the results of all the hydrographic data collected in the State of California during 1906.

GREAT BASIN DRAINAGE IN OREGON.

DESCRIPTION.

The Great Basin in Oregon comprises about one-fourth of the area of the State. The surface waters throughout this area drain into the natural depressions in the ground, the water either evaporating or, if the flow is sufficient, forming perennial lakes. The area is generally high and rolling, and the average elevation is about 4,000 feet. Forests, except on the borders of this basin, are small. The soil is rough, sparsely covered with grass, and is given largely to range for sheep and cattle. The rainfall throughout the basin is about 12 inches per annum. The principal lakes are Harney, Malheur, Warner, Summer, Silver, Christmas, Goose, and Abert. With the exception of Silver Lake, all are alkaline. The surface waters of this basin are very valuable for irrigation developments, but unfortunately are insufficient. The irrigated valley lands contiguous to the streams have been taken, and the low-water flow of the principal streams is entirely used.

Investigations of the surface-water supply in this basin has been limited to the following streams, which are classified by the lakes into which they flow: Silvies River, discharging into Malheur Lake; Silver Creek into Harney Lake; Silver, Bridge, and Bear creeks into Silver Lake; Summer Creek and Ana River into Summer Lake, and Chewaucan River into Abert Lake.

MALHEUR LAKE BASIN.

MALHEUR LAKE AT THE NARROWS, OREGON.

This station was established May 14, 1903, and discontinued March 31, 1906. It is located at the highway bridge across The Narrows. The station is maintained for the purpose of obtaining data in regard to the fluctuations of the lake, which has no outlet. The gage and the bench mark are described in Water-Supply Paper No. 176, page 121, where are given also references to publications that contain data for previous years.

The following gage heights were observed in 1906:

Gage heights of Malheur Lake at The Narrows, Oregon, in 1906.

	Feet.
January 6 to March 3	3.6
March 10	3.75
March 17 and 24	3.9
March 31	4.45

SILVIES RIVER NEAR BURNS, OREG.

This station was established May 10, 1903, and was discontinued July 24, 1906. It was located about 10 miles above Burns, Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 122, where are given also references to publications that contain data for previous years.

Discharge measurements of Silvies River near Burns, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 8	M. L. Lewis	55	396	7.40	479
May 23	do	67	544	5.30	330
June 29	Stevens and Landes	55	125	4.42	250

Daily gage height, in feet, of Silvies River near Burns, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	2.4	2.45	2.6	10.6	10.4	9.75	4.3
2	2.45	2.45	2.6	9.8	10.0	9.4	4.0
3	2.45	2.45	2.6	9.0	9.75	8.6	3.8
4	2.45	2.45	2.6	8.8	9.5	8.5	3.6
5	2.5	2.45	2.6	9.65	9.08	9.2	3.4
6	2.5	2.45	2.6	11.5	8.6	9.3	3.4
7	2.5	2.45	2.6	13.25	7.75	9.35	3.2
8	2.5	2.5	2.6	14.4	7.2	9.5	3.1
9	2.5	2.5	2.6	14.88	7.25	9.5	3.1
10	2.5	2.5	2.6	14.9	6.85	9.2	3.0
11	2.5	2.55	2.6	14.6	6.38	9.2	3.0
12	2.5	2.6	2.6	14.4	6.35	9.0	2.9
13	2.5	2.6	2.5	14.0	6.15	8.7	2.8
14	2.5	2.6	2.5	13.9	6.15	8.0	2.6
15	2.5	2.6	2.5	14.0	6.15	7.8	2.6
16	2.6	2.6	2.5	14.15	5.9	7.1	2.6
17	2.6	2.6	2.5	14.3	5.5	7.1	2.6
18	2.6	2.6	2.5	14.08	5.5	6.8	2.6
19	2.6	2.6	2.5	13.92	5.5	6.0	2.6
20	2.6	2.6	2.5	13.82	5.5	5.7	2.6
21	2.6	2.6	2.5	13.68	5.5	5.0	2.6
22	2.6	2.6	2.6	14.0	5.5	4.7	2.6
23	2.6	2.6	2.75	13.98	5.25	4.0	2.6
24	2.6	2.6	2.8	13.7	5.15	4.0	2.6
25	2.5	2.6	3.0	13.4	5.15	4.0	....
26	2.5	2.6	3.8	13.3	5.4	4.0	....
27	2.5	2.6	4.1	13.0	5.6	4.3	....
28	2.45	2.6	4.6	12.9	6.6	4.4	....
29	2.45	....	4.8	12.7	7.4	4.4	....
30	2.45	....	6.35	11.9	8.0	4.3	....
31	2.45	....	8.8	....	8.6	....	....

Rating table for Silvies River near Burns, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	11	3.50	110	4.60	209	6.40	371	8.60	569
2.50	20	3.60	119	4.70	218	6.60	389	8.08	587
2.60	29	3.70	128	4.80	227	6.80	407	9.00	605
2.70	38	3.80	137	4.90	236	7.00	425	10.00	700
2.80	47	3.90	146	5.00	245	7.20	443	11.00	810
2.90	56	4.00	155	5.20	263	7.40	461	12.00	935
3.00	65	4.10	164	5.40	281	7.60	479	13.00	1,100
3.10	74	4.20	173	5.60	299	7.80	497	14.00	1,412
3.20	83	4.30	182	5.80	317	8.00	515	15.00	2,080
3.30	92	4.40	191	6.00	335	8.20	533	16.00	3,170
3.40	101	4.50	200	6.20	353	8.40	551		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-6 and is not well defined for 1906.

Monthly discharge of Silvies River near Burns, Oreg., for 1906.

[Drainage area, 865 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	29	11	21.4	1,320	0.025	0.03
February	29	16	24.6	1,370	.028	.03
March	587	20	77.5	4,770	.090	.10
April	2,010	587	1,260	75,000	1.46	1.63
May	742	259	416	25,600	.481	.55
June	675	155	428	25,500	.495	.55
July (1-24)	182	29	65.8	3,130	.076	.07
The period	....	....	....	137,000	....	....

NOTE.—The open-channel rating table was applied throughout the period; values for the winter months may be somewhat in error on account of ice.

HARNEY LAKE BASIN.

SILVER CREEK NEAR RILEY, OREG.

Silver Creek rises in the extreme northwestern part of Harney County, Oreg., and flows southeastward into the north end of Harney Lake.

The gaging station was established April 19, 1904, and discontinued July 14, 1906. It is located 12 miles above Riley, Oreg., on the Burns-Shaniko stage line, and is 6 miles below the proposed reservoir site on Silver Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 125, where are given also references to publications that contain data for previous years.

Discharge measurements of Silver Creek near Riley, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 10	M. L. Lewis	34	54	6.10	64
June 1	Lewis and Stevens	45	130	8.10	184
June 27	I. Landes	34	46	5.78	43

Daily gage height, in feet, of Silver Creek near Riley, Oreg., for 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Feb.	Mar.	Apr.	May.	June.	July.
1	5.10	6.00	12.00	......	8.00	......	17	5.10	......	12.30	6.00	......	......
2	5.10	6.50	11.00	7.30	7.90	5.60	18	5.10	5.70	12.00	6.80	6.90	......
3	5.10	6.50	11.50	7.00	......	5.50	19	......	......	12.70	5.40	6.70	......
4	5.10	6.50	10.50	7.00	8.90	5.50	20	6.70	6.30	11.00	......	6.50	......
5	......	......	12.00	6.90	8.70	5.40	21	7.70	6.80	11.00	5.50	6.40	......
6	5.10	7.00	11.50	......	8.80	5.40	22	5.10	7.00	10.70	5.70	6.30	......
7	5.10	6.00	11.00	6.70	8.70	5.30	23	5.10	7.30	......	5.90	6.10	......
8	5.10	6.50	12.50	6.50	8.50	......	24	5.10	7.00	10.50	6.00	......	......
9	5.10	5.50	......	6.40	8.70	5.20	25	5.10	7.00	10.00	6.00	5.50	......
10	5.10	5.90	12.30	6.30	......	5.20	26	......	......	9.70	6.10	5.70	......
11	5.10	5.90	12.00	6.10	7.80	5.10	27	7.00	7.50	9.50	......	5.80	......
12	......	......	11.30	6.00	7.50	5.10	28	7.30	8.00	8.30	5.70	5.80	......
13	5.10	......	11.80	......	7.00	5.00	29	......	7.00	8.00	7.90	5.70	......
14	5.10	......	11.80	6.00	6.90	5.00	30	......	9.00	......	8.10	......	......
15	5.10	......	12.00	5.90	6.50	......	31	......	8.50	......	8.10	......	......
16	5.10	......	......	6.00	6.00	......							

Rating table for Silver Creek near Riley, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.20	.0	5.20	25	6.10	62	7.00	113	8.80	237
4.30	0.2	5.30	29	6.20	67	7.20	125	9.00	253
4.40	.6	5.40	33	6.30	72	7.40	137	9.20	269
4.50	1.0	5.50	37	6.40	77	7.60	150	9.40	285
4.60	3	5.60	41	6.50	83	7.80	164	9.60	302
4.70	6	5.70	45	6.60	89	8.00	178	9.80	320
4.80	9	5.80	49	6.70	95	8.20	192	10.00	338
4.90	13	5.90	53	6.80	101	8.40	206	11.00	428
5.00	17	6.00	57	6.90	107	8.60	221	12.00	518
5.10	21								

NOTE.—This table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and 2 during 1905 and is fairly well defined.

Monthly discharge of Silver Creek near Riley, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
February	157	21	38.7	2,150
March	253	37	92.5	5,690
April	581	162	435	25,900
May	185	33	82.5	5,070
June	245	37	123	7,320
July (1-14)	43	17	29.0	805
The period				46,900

NOTE.—The open-channel rating has been applied throughout the period; values for winter months are liable to some error on account of ice. Discharges have been interpolated for days on which gage was not read.

SILVER LAKE BASIN.

SILVER CREEK NEAR SILVER LAKE, OREG.

Silver Creek rises in the western part of Lake County, Oreg., flows northward to Pauline Lake and Marsh, then turns abruptly to the southeast and enters Silver Lake.

The gaging station was established December 29, 1904. It is located 0.9 mile above the county bridge, 1.6 miles southwest of Silver Lake, Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 176, page 127.

Discharge measurements of Silver Creek near Silver Lake, Oreg., in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	43	175	5.52	664	May 5	34	91	3.65	288
April 9	38	130	4.48	412	May 11	25.5	61	2.45	147
April 28	31	81	3.23	219	May 23	22	35	1.45	53
April 30	32	85	3.48	258					

Daily gage height, in feet, of Silver Creek near Silver Lake, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.85	0.95	1.0	2.2	3.4	2.15	0.9	0.7	0.7	0.65	0.65	0.4
2	.9	.9	.95	1.5	3.1	1.5	.85	.65	.7	.65	.7	.4
3	1.2	.5	.95	2.0	....	1.5	.85	.65	.7	.65	.65	.4
4	.9	.95	.6	1.8	3.25	1.3	.8	.65	.7	.65	.65	.4
5	.85	.85	.6	2.6	3.25	1.55	.8	.65	.7	.65	.75	.7
6	.85	1.1	.7	3.5	3.0	2.0	.8	.65	.7	.65	.7	.7
7	.8	.8	.9	4.3	3.0	1.8	.8	.65	.7	.65	.7	.7
8	.8	.95	.9	4.0	2.8	2.0	.8	.65	.7	.65	.7	.7
9	.9	.95	1.05	4.95	2.8	2.0	.75	.65	.7	.65	.75	.7
10	.9	1.0	1.0	4.8	2.6	1.8	.75	.65	.75	.65	.75	.75
11	.9	1.0	1.2	4.0	2.6	1.6	.75	.65	.75	.7	.65	.7
12	.95	1.15	1.6	4.2	2.3	1.4	.75	.75	.7	.7	.65	.7
13	.9	1.15	1.6	4.8	2.0	1.4	.75	.75	.7	.65	.65	.7
14	.95	1.0	1.4	4.6	2.1	1.4	.75	.7	.7	.65	.65	.75
15	.8	1.2	1.1	3.9	2.1	1.2	.8	.65	.7	.65	.65	.75
16	1.4	1.0	1.0	4.9	1.8	1.2	.8	.65	.7	.65	.65	.6
17	1.4	.8	.85	4.6	1.6	1.01	.75	.65	.7	.65	.65	.6
18	.85	1.8	.95	4.2	1.4	.9	.75	.65	.7	.65	.65	.6
19	.95	1.6	.8	4.2	1.4	.9	.75	.7	.7	.65	.65	.6
20	.85	1.3	.95	4.0	1.4	.9	.75	.7	.7	.65	.7	.6
21	.95	1.3	.85	4.9	1.35	.9	.75	.7	.7	.65	.7	.6
22	1.2	.95	.9	4.9	1.4	.9	.75	.7	.7	.65	.7	.65
23	.9	.8	.9	4.0	1.45	.9	.75	.75	.7	.65	.65	.7
24	1.0	.8	1.2	3.5	1.3	.9	.75	.7	.7	.65	.65	1.0
25	1.0	.65	1.2	3.0	1.3	.9	.75	.7	.7	.65	.7	2.1
26	.95	.8	1.55	2.6	2.0	1.0	.7	.65	.65	.65	1.0	2.1
27	.95	1.0	1.6	4.0	1.8	1.1	.65	.7	.65	.65	.8	2.1
28	.95	.85	1.5	3.4	2.0	1.0	.65	.7	.65	.65	.65	.7
29	.9	....	1.6	2.9	2.5	.95	.65	.7	.65	.65	.6	.65
30	.9	....	2.1	3.5	2.0	.9	.65	.75	.65	.65	.4	.7
31	.9	....	3.15	....	1.85	....	.65	.7	....	.65	....	.7

NOTE.—The creek was frozen at times from January 1 to April 2, the ice reaching a maximum thickness of 1.0 foot. There was also ice during the latter part of November.

Rating table for Silver Creek near Silver Lake, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	7	1.46	50	2.30	120	3.20	217	4.20	380
.60	10	1.50	57	2.40	129	3.30	231	4.40	420
.70	13	1.60	64	2.50	138	3.40	245	4.60	460
.80	17	1.70	71	2.60	148	3.50	260	4.80	500
.90	21	1.80	78	2.70	158	3.60	275	5.00	540
1.00	26	1.90	86	2.80	169	3.70	290	5.20	585
1.10	31	2.00	94	2.90	180	3.80	306	5.40	635
1.20	37	2.10	102	3.00	192	3.90	323		
1.30	43	2.20	111	3.10	204	4.00	340		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and is well defined.

Monthly discharge of Silver Creek near Silver Lake, Oreg., for 1906.

[Drainage area, 221 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per square mile.	Depth in inches.
January	50	17	24.2	1,490	0.110	0.13
February	78	7	27.8	1,540	.126	.13
March	210	10	40.4	2,480	.183	.21
April	530	57	320	19,000	1.45	1.62
May	245	43	118	7,260	.534	.62
June	107	21	45.8	2,730	.207	.23
July	21	12	15.4	947	.070	.08
August	15	12	12.8	787	.058	.07
September	15	12	12.6	750	.057	.06
October	13	12	12.1	744	.055	.06
November	26	5	12.9	768	.058	.06
December	102	5	20.5	1,260	.093	.11
The year	530	5	55.2	39,800	.250	3.38

NOTE.—The open-channel rating table was applied throughout the year; values for the winter months are probably somewhat in excess of the true discharge on account of ice.

BRIDGE CREEK NEAR SILVER LAKE, OREG.

Bridge Creek rises in western Lake County, Oreg., and flows northeastward into Silver Creek near the town of Silver Lake.

The gaging station was established January 21, 1905, and discontinued July 21, 1906. It was located at the county bridge 2 miles east of Silver Lake, Oreg. The conditions and the bench mark are described in Water-Supply Paper No. 176, page 129.

Discharge measurements of Bridge Creek near Silver Lake, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	I. Landes	11	7.7	2.39	10
May 29	do	12.5	9.2	2.52	10
June 22	Stevens and Landes	19.5	14	2.74	19

Daily gage height, in feet, of Bridge Creek near Silver Lake, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	2.60	2.60	2.50	2.31	2.89	2.65	2.73
2	2.60	2.60	2.60	2.31	3.00	2.65	2.75
3	2.60	2.60	2.50	2.30	2.98	2.66	2.75
4	2.60	2.70	2.50	2.32	2.95	2.67	2.83
5	2.60	2.70	2.50	2.32	3.00	2.70	2.85
6	2.60	2.70	2.50	2.32	2.98	2.70	2.89
7	2.70	2.80	2.50	2.32	2.98	2.75	2.85
8	2.70	2.80	2.40	2.32	3.00	2.8	2.60
9	2.70	2.80	2.40	2.33	2.90	2.83	2.59
10	2.70	2.80	2.40	2.50	2.98	2.75	2.60
11	2.70	2.80	2.50	2.50	2.80	2.75	2.58
12	2.80	2.80	2.50	2.52	2.85	2.76	2.56
13	2.80	2.80	2.60	2.45	2.80	2.76	2.56
14	2.80	2.70	2.60	2.35	2.79	2.76	2.54
15	2.80	2.70	2.60	2.33	2.83	2.76	2.40
16	2.80	2.70	2.60	2.33	2.80	2.75	2.40
17	2.80	2.80	2.60	2.34	2.85	2.78	2.30
18	2.80	2.70	2.50	2.34	2.83	2.79	2.30
19	2.80	2.70	2.40	2.35	2.80	2.80	2.28
20	2.80	2.70	2.40	2.34	2.70	2.82	2.27
21	2.70	2.70	2.40	2.34	2.68	2.82	2.27
22	2.70	2.70	2.30	2.40	2.65	2.80	....
23	2.70	2.70	2.15	2.50	2.65	2.79	....
24	2.60	2.70	2.20	2.65	2.64	2.75	....
25	2.60	2.50	2.40	2.68	2.63	2.75	....
26	2.50	2.50	2.40	2.70	2.60	2.74	....
27	2.50	2.50	2.40	2.68	2.64	2.73	....
28	2.60	2.60	2.40	2.60	2.64	2.70	....
29	2.60	....	2.50	2.80	2.63	2.72	....
30	2.60	....	2.50	2.85	2.64	2.70	....
31	2.60	....	2.50	....	2.65	....	....

NOTE.—Ice conditions January 1-March 7.

Rating table for Bridge Creek near Silver Lake, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	4	2.30	7	2.50	11	2.70	17	2.90	25
2.20	5	2.40	9	2.60	14	2.80	21	3.00	29

NOTE.—This table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Bridge Creek near Silver Lake, Oreg., for 1906.

Month.	Discharge in Second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	21	11	16.6	1,020
February	21	11	17.1	950
March	14	4	10.4	640
April	23	7	10.5	625
May	29	14	21.3	1,310
June	22	16	18.9	1,120
July (1-21)	25	6	14.0	583
The period				6,250

NOTE.—No correction made in discharge for ice conditions January 1 to March 7. It is probably in excess of the true value.

BEAR CREEK NEAR SILVER LAKE, OREG.

Bear Creek rises in western Lake County, Oreg., and flows northeastward into the western side of Pauline Lake and Marsh.

The gaging station was established January 21, 1905. It is located at the county bridge 3 miles northeast of Silver Lake, Oreg. The conditions and the bench mark are described in Water-Supply Paper No. 176, page 131.

Discharge measurements of Bear Creek near Silver Lake, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 9	I. Landes	10.5	13	4.48	27
May 29	do.	17.5	22	4.87	30
June 22	Stevens and Landes	18.7	29	6.23	65

NOTE.—These measurements were made below the bridge at different sections.

Daily gage height, in feet, of Bear Creek near Silver Lake, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	4.2	4.2	4.2	4.3	5.1	4.9	5.15
2	4.2	4.2	4.1	4.1	5.2	4.95	5.1
3	4.2	4.0	4.1	4.1	5.3	4.95	5.2
4	4.2	4.0	4.1	4.4	5.35	5.35	5.2
5	4.2	4.0	4.1	4.4	5.4	5.2	5.3
6	4.2	4.0	4.1	4.0	5.4	5.15	5.2
7	4.2	4.2	4.1	4.6	5.45	5.0	5.2
8	4.2	4.2	4.1	4.3	5.5	4.95	5.2
9	4.2	4.2	4.2	4.2	5.6	5.35	5.0
10	4.2	4.2	4.3	4.0	5.8	5.35	5.0
11	4.2	4.2	4.3	4.25	5.9	5.4	5.0
12	4.2	4.2	4.3	4.25	5.65	5.75	4.85
13	4.2	4.2	4.3	4.25	5.4	5.5	4.85
14	4.2	4.2	4.3	4.3	5.4	5.45	4.8
15	4.2	4.2	4.3	4.35	5.3	5.4	4.4
16	4.3	4.2	4.1	4.4	5.3	5.75	4.3
17	4.3	4.2	4.0	4.35	5.2	5.6	4.4
18	4.2	4.4	4.0	4.3	5.1	5.5	4.2
19	4.2	4.4	4.1	4.9	5.0	5.5	4.1
20	4.2	5.0	4.1	5.0	5.2	5.4	....
21	4.2	5.0	4.1	5.15	5.05	5.4	....
22	4.2	5.0	4.2	5.2	4.95	5.35	....
23	4.2	4.4	4.2	5.2	4.7	5.2	....
24	4.2	4.4	5.15	5.0	4.7	5.2	....
25	4.2	4.4	5.2	4.95	5.0	5.2	....
26	4.2	4.4	5.1	4.95	5.1	5.35	....
27	4.2	4.4	4.6	4.9	5.1	5.5	....
28	4.2	4.4	4.5	5.0	5.1	5.3	....
29	4.2	....	4.4	5.0	5.0	5.05	....
30	4.2	....	5.1	5.0	4.85	5.25	....
31	4.2	....	4.95	....	4.9	....	....

NOTE.—The creek was frozen from January 1 to about March 20. The thickness of ice was measured as follows: January 5, 13, 20, and 27, February 3, 10, 17, and 24, and March 2, 1.1 feet; March 17, 0.2 foot. There was backwater from the dam of an irrigating ditch after April 19.

ABERT LAKE BASIN.

CHEWAUCAN RIVER AT PAISLEY, OREG.

Chewaucan River rises in south-central Lake County, Oreg., flows northwest, then northeast, and then southeast, and discharges into the south end of Abert Lake. The changes in course are very abrupt.

The gaging station was established January 4, 1905. It is located one-half mile above Paisley, Oreg. The conditions and the bench mark are described in Water-Supply Paper No. 176, page 133.

Discharge measurements of Chewaucan River at Paisley, Oreg., by I. Landes, in 1905–6.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1905.					1906.				
December 17[a]	32	57	3.90	40	May 0	52	165	6.60	799
					May 25	47	119	5.72	462
1906.					May 26	43.5	131	5.98	547
April 0	47	147	6.17	567	May 27	42	123	5.80	480
April 7	45	136	5.90	465	June 25	40	97	5.08	293
April 25	45	136	5.98	505					

[a] Measured through ice 0.3 foot thick.

Daily gage height, in feet, of Chewaucan River at Paisley, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.3	3.9	4.1	5.3	6.4	5.5	4.9	3.7	3.6	3.6	3.8	3.8
2	4.0	3.9	4.0	5.0	6.5	5.5	4.8	3.7	3.6	3.6	3.8	3.8
3	3.9	3.9	4.0	4.8	6.7	5.0	4.7	3.7	3.6	3.6	3.8	3.7
4	3.9	4.3	4.1	5.0	6.8	6.0	4.7	3.7	3.6	3.7	3.8	3.7
5	3.9	3.9	4.0	5.2	6.9	6.0	4.8	3.6	3.7	3.7	3.8	......
0	3.9	4.0	4.1	5.94	6.9	6.3	4.7	3.0	3.7	3.7	3.8	4.0
7	3.9	3.9	4.1	6.0	6.8	6.0	4.7	3.6	3.7	3.7	3.9	3.9
8	3.9	3.9	4.2	6.4	6.8	5.8	4.5	3.6	3.7	3.7	3.9	3.9
9	3.9	3.9	4.3	0.5	6.9	6.0	4.5	3.6	3.7	3.7	3.8	3.9
10	3.9	3.8	4.4	6.2	7.0	5.9	4.4	3.6	3.7	3.7	......	3.9
11	4.0	3.8	4.4	5.8	7.0	5.8	4.3	3.7	......	3.7	3.8	4.0
12	4.0	3.8	4.0	5.7	6.9	0.0	4.3	3.7	3.8	......	3.8	3.9
13	4.0	3.8	4.0	5.9	6.6	5.8	4.3	3.6	4.0	3.7	3.8	3.9
14	4.0	3.8	4.1	6.1	6.6	5.7	4.3	3.6	3.9	3.7	3.8	3.9
15	3.9	3.8	4.1	6.1	6.6	5.7	4.2	3.6	3.8	3.7	4.0	3.9
16	4.0	3.8	4.0	6.4	6.3	5.7	4.2	3.6	3.7	3.7	......	3.9
17	4.1	3.8	4.0	6.5	6.1	5.6	4.3	3.6	3.7	3.7	3.8	3.9
18	4.0	4.0	4.1	6.3	6.0	5.5	4.2	3.6	3.7	3.7	3.8	3.9
19	4.1	4.1	4.1	0.5	5.9	5.5	4.1	3.6	3.7	3.7	3.8	3.9
20	4.2	4.0	4.0	6.7	5.9	5.4	4.1	3.0	3.7	3.7	3.8	3.9
21	4.3	4.1	4.2	0.7	5.9	5.3	4.0	3.6	3.7	......	3.9	3.8
22	4.1	4.0	4.8	6.7	5.6	5.3	4.0	3.6	3.7	3.8	3.8	3.8
23	4.1	4.0	5.0	5.4	5.6	5.2	4.0	3.6	3.7	3.8	3.7	3.8
24	3.9	4.0	4.9	6.2	5.5	5.1	4.0	3.6	3.7	3.7	......	4.0
25	3.9	3.9	5.3	6.1	5.5	5.1	3.9	3.6	3.7	3.7	3.8	4.7
26	3.8	3.0	5.3	5.8	6.1	5.4	3.8	3.0	3.7	3.7	3.8	......
27	3.8	4.3	5.1	5.9	5.8	5.4	3.8	3.6	3.7	3.7	3.8	4.5
28	3.9	4.1	5.0	5.9	5.9	5.3	3.8	3.6	3.7	3.7	3.8	4.3
29	3.8	......	5.2	6.0	5.7	5.1	3.7	3.6	3.6	3.7	3.8	4.1
30	3.8	......	6.3	6.3	5.6	5.0	3.7	3.6	3.6	3.7	3.8	4.0
31	3.9	......	6.5	......	5.7	......	3.7	3.6	......	3.8	......	3.5

NOTE.—The river was frozen, but not entirely over, January 1 to February 12, average thickness of ice, 0.5 foot; also December 15 to 31.

Rating table for Chewaucan River at Paisley, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.50	23	4.30	112	5.10	284	5.90	503	6.70	838
3.60	29	4.40	129	5.20	309	6.00	535	6.80	890
3.70	36	4.50	148	5.30	335	6.10	569	6.90	945
3.80	45	4.60	168	5.40	361	6.20	606	7.00	1,000
3.90	56	4.70	189	5.50	387	6.30	647		
4.00	68	4.80	211	5.60	414	6.40	692		
4.10	81	4.90	235	5.70	442	6.50	739		
4.20	96	5.00	259	5.80	472	6.60	788		

NOTE.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined.

Monthly discharge of Chewaucan River at Paisley, Oreg., for 1906.

[Drainage area, 272 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft per sq. mile.	Depth in inches.
January	112	45	65.4	4,020	0.241	0.28
February	112	45	62.1	3,450	.228	.24
March	739	68	173	10,600	.636	.73
April	838	211	551	32,800	2.03	2.26
May	1,000	387	671	41,300	2.47	2.85
June	647	259	415	24,700	1.53	1.71
July	235	36	110	6,760	.405	.47
August	36	29	30.4	1,870	.112	.13
September	68	29	37.1	2,210	.136	.15
October	45	29	35.2	2,160	.129	.15
November	68	36	46.8	2,780	.172	.19
December	189	23	66.7	4,100	.245	.28
The year	1,000	23	189	137,000	.694	9.44

NOTE.—The open-channel rating table has been applied throughout the year; values for the winter months are liable to some error on account of ice. Discharges interpolated for days on which gage was not read.

MISCELLANEOUS MEASUREMENTS.

The following measurements were made of minor streams of the Great Basin, in 1906, by J. F. Hoyt and others.

Miscellaneous measurements in Great Basin in 1906.

Date.	Stream.	Locality.	Area of section.	Mean velocity.	Gage height.	Discharge.
	IN UTAH.					
1906.			*Sq. ft.*	*Feet per sec.*	*Feet.*	*Sec.-ft.*
June 4	North ditch of Nephi Irrigation Co.	½ mile north of San Pedro depot.	5.1	1.77	....	9.07
Aug. 3	Rating flume...............	Wilson canal................	14.9	.95	....	14.2
June 26	Indian Creek..............	Above head of T. F. & B. Co..	5.3	2.97	....	15.6
27	Wildcat Creek	E. Gillie's ranch.............	1.2	1.84	....	2.25
27	Pine Creek............ ...	G. Bradshaw's ranch.........	8.4	2.70	1.4	9.06
28	Kesler ditch....	(Containing water of Cove Creek).	.48	1.25	1.0	.61
28	North Fork Pine Creek.....	Below county road crossing.	1.1	1.84	.7	1.97
July 4	Hutchins and Thompson ditch.	125 feet below head..........	1.8	1.44	....	2.58
4	Beaver City irrigation canal.	In flume.....................	9.8	3.10	....	30.3
4	Harris ditch...............	Beaver City canal flume......	7.9	3.25	....	25.6
4	Beaver City power canal .	Near Harris ditch	5.7	2.44	....	13.8
6	North Fork South Creek...	Cox Bros. ranch....	.77	.47	....	.36
6	Birch Creek...............	Above mouth Lower Birch Canyon.	2.3	1.4	....	3.28
11	A. Bayter's dug well and springs.	....	.42	.30	....	.11
12	N. Green's springs	Near fence No. 48...........	.25	.99	....	.25
13	G. B. and D. M. Gillie's springs.	SE. ¼, sec. 4, T. 29 S., R. 7 W..	....	....	....	.82
13	2 springs forming part of Dry Creek.	On Hannah Gales's farm	1.47	.92	....	1.35
13	2 springs forming part of Dry Creek.	In O. W. Gales's pasture.....	....	....	....	.68
14	Farnsworth and Bastian Bros.' springs.	On Indian Creek..............	....	....	....	.11
20	Joddy Dean's dug well....	Beaver City [a]...............	.26	.94	....	.25
20	J. H. Cartwright spring	Beaver City [a]...............	.11	.42	....	.05
20	W. E. Yardley's 2 springs	Beaver City [a]...............	.34	.67	....	.23
20	Part of seepage water.. ..	E. Willden's yard [a]...........	....	....	....	6.72
23	Remainder seepage water...	E. Willden's yard, Beaver City. [a]	....	....	....	1.30
	Total	....			....	8.02
	Discharge of surface stream.	....			....	.06
	Seepage	....			....	7.96
23	Irrigation ditch... ...	Beaver City [b].	3.09	1.38	....	4.23
23	Irrigation ditch	Beaver City [c]..	2.17	1.86	....	4.04
28	Jos. Jacksons's 2 springs...	South Beaver.....	.53	.69	....	.37
31	North Fork South Creek [d] .	Cox Bros. ranch..	.51	.50	....	.26
31	South Fork South Creek	Cox Bros. ranch.. ..	....	....	....	2.81
31	Birch Creek (Estimated) .	.. ..	....	....	....	2.00
	Total . .	.. ..	....	....	....	5.06
Aug. 21	Datson's warm springs..	1 mile east of Minersville	....	....	....	.13
25	Birch Creek..	Mouth Lower Birch Creek Canyon	....	....	....	.93
25	North Fork South Creek.	Cox Bros. ranch..	.44	.34	....	.15
	IN OREGON					
Apr. 8 [e]	Ana River	Summer Lake....	52	....	3.46	141
May 31	Chocloo Creek	Sycan Marsh.....	16	....	....	24
31	Coyote Creek. .	do....	2.9	....	....	4.5
31	Long Creek.	do.... .	39	....	....	60
July 2 [f]	Silvies.	Silvies... .	127	....	3.88	80

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[a] Mr. Deans's well flows rarely, even during the high water season. It is situated at the foot of a low beach in what has been a belt of marshy ground during high water seasons. In this belt are a dozen such wells and cellars discharging similar streams, some of them being given above.

[b] Ditch flows west on street 3 blocks north and 2 blocks west of W. M. & Co.'s store, measured at schoolhouse corner.

[c] Same ditch as at point 40 feet west of street 3 blocks east of Main street.

[d] This discharge is about twice the mean daily discharge, the flow almost ceasing at times.

[e] The discharge of this stream remains practically constant at 140 to 150 second-feet, as it heads in large springs; see Water-Supply Paper No. 176, p. 132.

[f] Measured from cable at station described in Water-Supply Paper No. 176, p. 122.

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Water-Supply and Irrigation Paper No. 213 Series P, Hydrographic Progress Reports, 67

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

THE SURFACE WATER SUPPLY OF CALIFORNIA, 1906

WITH A SECTION ON GROUND WATER LEVELS IN SOUTHERN CALIFORNIA

(GREAT BASIN AND PACIFIC OCEAN DRAINAGES
IN CALIFORNIA AND LOWER COLORADO
RIVER DRAINAGE)

W. B. CLAPP
DISTRICT HYDROGRAPHER

IN COOPERATION WITH CALIFORNIA STATE BOARD OF EXAMINERS

WASHINGTON
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SURFACE WATER SUPPLY OF CALIFORNIA 1906.[a]

W. B. Clapp,
District Hydrographer.[b]

INTRODUCTION.

SCOPE OF WORK.

The water supply of the United States is of more importance to the life and pursuits of the people than is any other natural resource. In the arid States the limit of agricultural development is determined by the amount of water available for irrigation; while in all parts of the country the increase in the population of cities and towns makes necessary additional water supplies for domestic and industrial uses, in procuring which both the quantity and the quality of the water that may be obtained must be considered. The location of manufacturing plants may depend largely on the water-power facilities and on the character of the water. The notable advances made in the electric transmission of power have led to the utilization of water powers for the operation of manufacturing establishments, railroads, and municipal lighting plants, many of which are at some distance from the places at which the power is developed.

The intelligent establishment and maintenance of enterprises or industries that depend on the use of water demands a thorough knowledge of the flow of the streams and an understanding of the conditions affecting that flow. This knowledge should be based on data showing both the total flow and the distribution of the flow throughout the year, in order that normal fluctuations may be provided for. As the flow of a stream is variable from year to year estimates of future flow can be made only from a study of observations covering several years. The rapid increase in the development of the water resources of the United States has caused a great demand by engineers for information in regard to the flow of streams, as it is now generally realized that the failure of many large power, irrigation, and other projects has been due to the fact that the plans were made without sufficient trustworthy information in respect to the water supply.

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[a] This report contains information similar to that published in previous years under the title "Report on Progress of Stream Measurements."

[b] The data in this report have been collected under the direction of W. B. Clapp, assisted by W. F. Martin, R. S. Hawley, C. H. Lee, and W. C. Sawyer, and have been prepared for publication under the direction of John C. Hoyt, by R. H. Bolster, Robert Follansbee, F. F. Henshaw, J. E. Stewart, and H. D. Padgett.

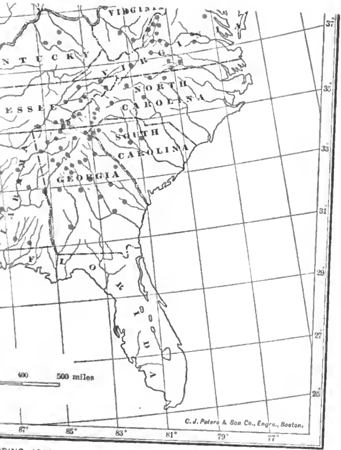
Owing to the broad scope of these hydrographic investigations and the length of time they should cover in order that the records may be of greatest value, it is, in general, impossible for private individuals to collect the necessary data, and as many of the streams traverse more than one State this work does not properly fall within the province of the State authorities. The United States Geological Survey has therefore, by means of specific appropriations by Congress, for several years systematically made records of stream flow, with the view to ultimately determining all the important features governing the flow of the principal streams of the country. In carrying out this plan stations are established on the streams and maintained for a period long enough to show their regimen or general behavior. When a record that is sufficient for this purpose has been obtained for any stream, the work on that stream is discontinued. The order in which the streams are measured is determined by the degree of their importance.

During 1906 the regimen of flow was studied at about 700 stations distributed along the various rivers throughout the United States, as shown on Pl. I. In addition to these records, data in regard to precipitation, evaporation, water power, and river profiles were obtained in many sections of the country.

These data have been assembled by drainage areas and are published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 201 to 214, inclusive, each of which pertains to the surface-water resources of a group of adjacent areas. In these papers are embodied not only the data collected in the field, but also the results of computations based on these data, and other information that has a direct bearing on the subject, such as descriptions of basins and the streams draining them, utility of the water resources, etc. The list follows:

Water-Supply and Irrigation Papers on Surface Water Supply, 1906.

201. Surface water supply of New England, 1906. (Atlantic coast of New England drainage.)
202. Surface water supply of the Hudson, Passaic, Raritan, and Delaware river drainages, 1906.
203. Surface water supply of the Middle Atlantic States, 1906. (Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.)
204. Surface water supply of the Southern Atlantic and Eastern Gulf States, 1906. (Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages.)


VIRGINIA
KENTUCKY
VIRGINIA
NORTH CAROLINA
TENNESSEE
SOUTH CAROLINA
GEORGIA
FLORIDA
37°
35°
33°
31°
29°
27°
25°
400
500 miles
C. J. Peters & Son Co., Engrs., Boston.
87°
85°
83°
81°
79°
77°

RING 1906.

1

2

2

2

2

205. Surface water supply of the Ohio and lower eastern Mississippi river drainages, 1906.
206. Surface water supply of the Great Lakes and St. Lawrence River drainages, 1906.
207. Surface water supply of the upper Mississippi River and Hudson Bay drainages, 1906.
208. Surface water supply of the Missouri River drainage, 1906.
209. Surface water supply of the lower western Mississippi River drainage, 1906.
210. Surface water supply of the western Gulf of Mexico and Rio Grande drainages, 1906.
211. Surface water supply of the Colorado River drainage above Yuma, 1906.
212. Surface water supply of the Great Basin drainage, 1906.
213. Surface water supply of California, 1906. (The Great Basin and Pacific Ocean drainages in California, and Colorado River drainage below Yuma.)
214. Surface water supply of the North Pacific Coast drainage, 1906.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing such records up to and including 1903 has been published in Water-Supply Paper No. 119. The following table gives, by years and primary drainage basins, the numbers of the papers on surface water supply, published from 1901 to 1906.

Numbers of Water-Supply Papers containing results of stream measurements, 1901–1906.[a]

	1901.	1902.	1903.	1904.	1905.	1906.
	No.	*No.*	*No.*	*No.*	*No.*	*No.*
Atlantic Coast of New England drainage	65 75	82	97	124	165	201
Hudson, Passaic, Raritan, and Delaware river drainages	65 75	82	97	125	166	202
Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages	65 75	82 83	97 98	126	167	203
Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages	65 75	83	98	127	168	204
Ohio and lower eastern Mississippi river drainages	65 75	83	98	128	169	205
Great Lakes and St. Lawrence River drainages	65	83	97	129	170	206
Hudson Bay and upper eastern and western Mississippi River drainages	65 66 75	83 84 85	98 99 100	128 130	171	207
Missouri River drainage	66 75	84	99	130 131	172	208
Meramec, Arkansas, Red, and lower western Mississippi river drainages	66 75	84	99	131	173	209
Western Gulf of Mexico and Rio Grande drainages	66 75	84	99	132	174	210
Colorado River drainage above Yuma	66 75	85	100	133	175	211
The Great Basin drainage	66 75	85	100	133	176	212
The Great Basin and Pacific Ocean drainages in California, and Colorado River drainage below Yuma	66 75	85	100	134	177	213
North Pacific Coast drainage	66 75	85	100	135	178	214

[a] Reports containing data for years prior to 1901 are noted in the series list at the end of this paper.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbrevation for cubic foot per second and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot: One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION AND USE OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of monthly and yearly discharges and run-off.
6. Tables showing discharge and horsepower and the number of days during the year when the same are available.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of the hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The discharge measurements and gage heights are the base data from which the other tables are computed. In cases of extensive development it is expected that engineers will use these original data in making their calculations, as the computations made by the Survey are based on the data available at the time they are made and should be reviewed and, if necessary, revised when additional data are available.

The rating table gives the discharge in second-feet corresponding to various stages of the river as given by the gage heights. It is published to enable engineers to determine the daily discharge in case this information is desired.

In the table of monthly discharge the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the remaining columns, which are defined on page 10, are based.

The values in the table of monthly discharge are intended to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

In most work where data in regard to flow are used the regimen of flow is of primary importance. Therefore for the principal stations tables have been prepared showing the horsepower that can be developed at various rates of flow, and the length of time that these rates of flow and the corresponding horsepower are available. These tables have been prepared on a basis of 80 per cent efficiency on the turbines, and the horsepower per foot of fall is given in order that the reader can determine the horsepower for any fall.

In the computations, sufficient significant figures have been used so that the percentage of error in the tables will not in general exceed

1 per cent. Therefore, most of the values in the tables are given to only three significant figures. In making the various computations, Thatcher's slide rule, Crelle's tables, and computation machines have been generally used.

In order to give engineers an idea of the relative value of the various data, notes in regard to accuracy are given as far as possible. This accuracy depends on the general local conditions at the gaging stations and the amount of data collected. Every effort possible is made to so locate the stations that the data collected will give a high degree of accuracy. This is not always possible, but it is considered better to publish rough values with explanatory notes rather than no data.

In the accuracy notes the following terms have been used, indicating the probable accuracy, in per cent, of the mean monthly flow. As these values are mean values, the error in the value for the flow of any individual day may be much larger.

Excellent indicates that the mean monthly flow is probably accurate to within 5 per cent; good, to within 10 per cent; fair, to within 15 per cent; approximate, to within 25 per cent.

CONVENIENT EQUIVALENTS.

Following is a table of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.

100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of theoretical power.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geological Survey) and No. 95 (Accuracy of Stream Measurements). In order that persons using this report may readily become acquainted with the general methods employed, the following brief descriptions are given:

Streams may be divided, with respect to their physical conditions, into three classes: (1) Those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In determining the daily flow special methods are necessary for each class. The data upon which the determinations are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen for any case depends upon the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{R\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir method.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed, they may be utilized for obtaining reliable measurements of flow. The conditions necessary to insure good results may be divided into two classes: (1) Those relating to the physical characteristics of the dam itself and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Papers Nos. 180 and 200[a]); (*f*) either no flash boards or exceptional care in reducing leakage through them and in recording their condition.

Preferably, there should be no diversion of water through or around the dam. Generally, however, a dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such determinations of flow the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

The combination of physical conditions and uses of the water should be such that the determinations of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

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[a] Water-Supply Paper No. 200 replaces No. 150, the edition of which has been exhausted.

A gaging station at a weir or dam has the general advantage of continuity of record through the period of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends upon the contour of the bed and the fluctuations of the water surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same, whether the velocity is determined by meters or floats. They are located, as far as possible, where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character, and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and of dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

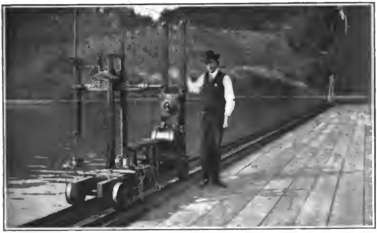
The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type, so constructed that the impact of flowing water causes it to revolve, and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds, and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

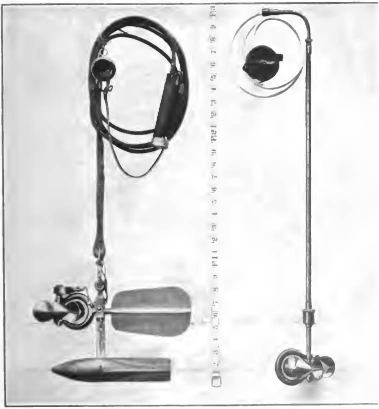
Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, shown in Pl. II, *B*, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging



A. CURRENT-METER RATING STATION, LOS ANGELES, CAL.



B. PRICE CURRENT METERS

section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates, and drawing a smooth curve among the resulting points, the vertical velocity-curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method, its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

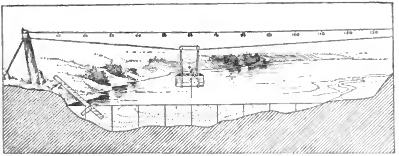


FIG. 1.—Cable station, showing section of river, car, gage, etc.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions, and, moreover, the indications are that it holds nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. This method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity, or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.5 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in the majority of measurements. A large number of vertical velocity-curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface, and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement, either by using the meter and cable, or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to the lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8, and vertical velocity-curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc.

From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice.

For information in regard to flow under ice cover see Water-Supply Paper No. 187.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of determining run-off, depending on whether or not the bed of the stream is permanent.

For stations on streams with permanent beds the first step in computing the run-off is the construction of the rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open, permanent channels: (1) The discharge will remain constant so long as the conditions at or near the gaging station remain constant; (2) the discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected; (3) the discharge is a function of and increases gradually with the stage.

The plotting of the results of the various discharge measurements, using gage heights as ordinates, and discharge, mean velocity, and area as abscissas, will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve, with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly upon the surface slope, the roughness of the bed, and the cross section of the stream. Of these the slope is the principal factor. In accordance with the relative change of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may, however, best be located between and beyond the measurements by means of curves of area and mean velocity. This curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall either be constant or increasing.

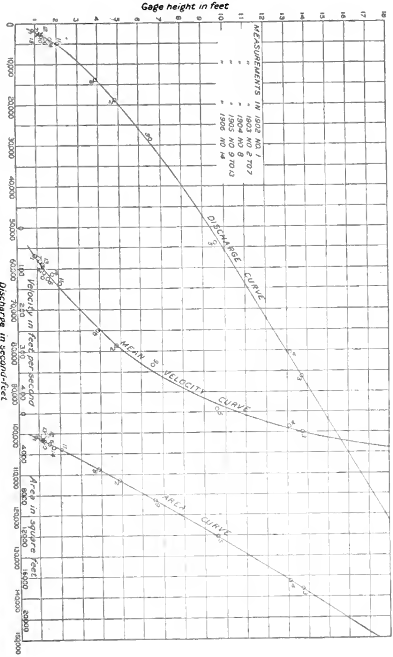


FIG. 2. Discharge, area, and mean-velocity curves of Potomac River at Point of Rocks, Md.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, the discharge can be determined by its use. In case of velocity-area stations frequent discharge measurements must be made if the determinations of flow are to be other than rough approximations. For stations with beds which shift slowly, or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in determining the flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

The hydrographic work of the United States Geological Survey in California is being carried on in cooperation with the State in accordance with acts of the State legislature approved March 16, 1903, and March 20, 1905.

The act of March 16, 1903, which covered the period from July 1, 1903, to June 30, 1905, is in substance as follows:

> The State board of examiners are hereby empowered to enter into contracts with the Director of the United States Geological Survey for the purpose of making topographic maps to the extent of twenty thousand dollars; also for the purpose of gaging streams, surveying reservoir sites and canal locations, for the conservation and utilization of the flood or storm waters of the State, to the extent of fifteen thousand dollars [etc.].

The act of March 20, 1905, is in substance the same as previous act, the appropriations being increased to $30,000 for topography and $20,000 for hydrography, and covering the two fiscal years July 1, 1905, to June 30, 1907.

Assistance has been rendered or records furnished by the following, to whom acknowledgment is due: California State board of examiners, composed of the following members: George C. Pardee, governor; C. F. Curry, secretary of state; U. S. Webb, attorney-general. Acknowledgment is also due to Mr. Lovelace, of Lemoore, Cal., for gage readings on Tulare Lake; to the Kern County Land Company, through A. K. Warren, engineer in charge of water measurements, for the record of Kern River; to the city of Santa Barbara for cooperation in gaging Santa Ynez River; to the Bay Cities Water Company, through Edwin Duryea, jr., chief engineer, for precipitation and run-off data; to the Great Western Power Company, through Mr. M. A. Viele, chief engineer, for gage heights and stream measurements on Feather River and tributaries and for rainfall and evaporation records near Prattville, Cal.; to the Southern Pacific Company, through its chief engineer, William Hood, for river-stage records of San Joaquin River at Herndon, Cal., and for transportation furnished; and to the officials of the Santa Fe Railway for transportation furnished.

LOWER COLORADO RIVER DRAINAGE BASIN.[a]

COLORADO RIVER AT HARDYVILLE, ARIZ.

This station was established May 11, 1905. It is located one-fourth mile above the deserted town of Hardyville, and 7 miles above Fort Mohave, Ariz. The conditions at this station and the bench marks are described in Water-Supply Paper No. 175, page 128.

Discharge measurements of Colorado River at Hardyville, Ariz., in 1905–6.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
1905.		*Feet.*	*Sec.-ft.*	1906.		*Feet*	*Sec.-ft*
May 17	O. W. Peterson	6.65	33,140	April 8	C. W. Jenkins	6.90	21,500
May 20	do	6.95	33,910	April 15	do	7.30	24,100
May 27	C. W. Jenkins	11.20	69,010	April 22	do	8.10	32,200
June 4	do	10.50	64,750	April 24	Murphy and Lee	8.84	37,500
June 10	do	14.50	107,700	May 3	Lee and Jenkins	9.00	40,800
June 18	do	12.80	81,030	May 6	C. W. Jenkins	8.70	33,100
June 25	do	10.15	52,840	May 13	do	11.20	67,200
July 9	do	6.70	30,650	May 20	C. H. Lee	11.90	63,700
July 16	do	5.70	22,400	May 27	C. W. Jenkins	14.00	92,800
July 23	do	5.10	17,420	June 3	do	14.05	96,200
July 30	do	4.60	14,590	June 9	do	13.10	92,000
August 6	do	5.00	17,040	June 16	do	14.70	109,000
August 13	do	4.20	12,270	July 1	F. T. Cavin	10.35	63,700
August 27	do	4.00	11,650	July 8	Lee and Cavin	19.30	47,500
September 2	do	3.20	5,934	July 15	F. T. Cavin	8.50	34,600
September 17	do	3.40	7,523	July 22	do	8.56	38,100
October 1	do	3.00	4,657	July 29	do	7.55	27,600
October 15	do	3.90	6,579	August 5	do	7.35	24,400
October 29	do	3.60	6,574	August 11	do	7.00	19,500
November 4	Jenkins and Lee	3.48	5,949	August 18	do	6.45	16,200
November 12	C. W. Jenkins	3.85	6,504	August 25	do	6.20	14,200
November 19	do	3.70	5,979	September 1	do	6.50	15,500
November 25	do	3.40	5,757	September 8	do	6.43	12,700
December 3	do	6.00	17,850	September 15	do	6.50	11,400
				September 22	C. J. Brink	6.73	12,100
1906.				September 29	do	7.38	16,900
January 1	C. W. Jenkins	3.70	3,430	October 6	do	7.63	16,000
January 7	do	3.50	3,440	October 13	do	7.00	12,000
January 14	do	3.30	3,340	October 20	do	6.75	9,840
January 21	do	4.15	5,900	October 28	do	6.60	8,400
January 28	do	4.50	7,850	November 4	do	6.80	9,470
February 5	do	4.10	5,110	November 10	do	7.30	12,800
February 12	do	4.40	6,390	November 17	do	7.15	10,300
February 25	do	4.30	6,350	November 24	do	6.85	9,430
March 4	do	4.10	5,710	December 1	do	6.70	7,720
March 11	do	4.20	1,520	December 8	do	8.48	23,300
March 18	do	6.40	19,400	December 15	do	7.25	11,300
March 25	do	5.80	12,800	December 22	do	6.89	9,230
April 1	do	7.50	30,000	December 29	do	6.50	7,160

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[a] A description of the general features of Colorado River drainage will be found in Water-Supply Paper No. 211.

Daily gage height, in feet, of Colorado River at Hardyville, Ariz., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1						[a]11.8	8.55	4.5	3.4	3.75	3.45	7.4
2						[a]11.5	8.4	4.5	3.4	4.05	3.45	7.1
3						[a]11.1	8.3	[a]4.65	3.2	4.7	3.5	6.05
4						10.7	8.0	4.8	3.2	4.35	3.45	5.35
5						10.8	7.9	5.2	3.45	5.1	3.5	4.8
6						11.85	7.55	5.0	3.55	4.8	3.5	4.5
7						12.5	7.3	4.7	3.5	4.8	3.6	4.3
8						13.1	7.0	4.7	3.6	4.7	4.0	[a]4.2
9						13.7	6.7	4.85	3.5	4.7	3.85	4.1
10						14.4	6.7	4.6	3.6	4.45	3.85	3.9
11					6.85	14.3	6.5	4.5	4.0	4.25	3.75	3.75
12					6.9	14.0	6.15	4.3	3.7	4.1	3.85	3.75
13					6.95	14.3	[a]6.0	4.25	3.5	[a]4.0	3.8	3.8
14					7.15	14.45	5.85	[a]4.15	3.5	3.95	3.65	3.8
15					7.15	14.5	5.2	4.0	3.45	3.85	3.85	3.7
16					6.95	13.8	5.85	4.0	3.45	3.8	3.75	3.7
17					6.7	13.3	5.5	3.9	3.4	3.7	3.7	3.7
18					6.8	12.8	5.3	3.8	3.3	3.7	3.7	3.7
19					6.95	12.5	5.25	3.8	3.2	3.7	3.7	3.6
20					7.0	12.2	[a]5.2	3.8	3.2	3.6	3.7	3.6
21					7.35	11.85	5.1	3.75	3.05	3.55	3.6	[a]3.65
22					8.1	11.35	5.1	3.75	3.05	3.5	3.6	3.7
23					8.8	10.8	5.1	3.6	3.0	3.5	3.6	3.8
24					9.5	10.5	4.95	3.6	3.05	[a]3.5	3.7	3.8
25					9.9	10.15	4.85	3.6	2.95	3.45	3.6	3.8
26					10.6	10.0	4.7	4.75	2.95	3.5	5.4	3.95
27					11.1	9.5	4.7	3.7	2.95	3.45	5.4	3.9
28					11.5	9.1	4.7	3.4	2.95	3.5	5.1	3.9
29					12.7	9.2	4.7	3.3	3.95	3.55	5.0	3.9
30					[a]12.4	9.6	4.65	3.4	3.95	3.5	5.1	3.8
31					[a]12.1	......	4.6	3.4	......	3.5	......	[a]3.8
1906.												
1	[a]3.7	[a]4.2	4.4	7.85	9.5	13.2	10.25	7.4	6.5	[a]7.55	6.65	6.7
2	3.5	4.1	4.2	8.25	9.2	13.8	10.0	7.4	6.35	7.5	6.6	6.65
3	3.5	4.05	4.2	7.9	9.1	14.0	9.7	7.6	6.35	7.7	[a]6.7	6.7
4	3.4	4.1	4.1	7.4	9.2	13.8	9.4	7.5	6.5	7.7	6.8	6.65
5	3.35	4.1	4.1	7.45	8.9	13.75	9.4	7.35	6.5	7.7	6.75	6.6
6	3.4	4.1	4.1	7.1	8.8	13.8	9.2	7.2	6.55	7.6	[a]6.8	6.8
7	3.5	4.2	4.1	6.85	8.7	13.6	9.35	7.0	6.55	7.4	6.9	7.45
8	3.35	4.2	4.2	6.9	8.1	13.3	9.25	7.1	6.7	7.3	6.9	8.45
9	3.3	4.3	4.2	6.9	8.7	13.0	9.35	7.0	6.7	7.2	7.0	7.9
10	3.45	4.1	4.2	6.9	9.3	13.1	9.1	7.0	6.7	7.1	7.3	7.7
11	3.3	[a]4.4	4.25	7.1	10.1	13.25	8.9	7.05	6.55	7.1	7.3	[a]7.6
12	3.35	4.4	4.2	7.1	10.5	13.5	8.8	6.85	6.6	7.1	[a]7.3	7.5
13	3.3	4.4	4.35	7.6	11.05	13.1	8.8	6.8	6.55	7.0	7.3	7.4
14	3.4	4.4	4.5	7.5	11.85	13.95	8.45	6.7	6.55	7.0	7.2	7.3
15	3.35	4.3	5.1	7.35	11.9	[a]14.0	8.5	6.65	6.55	6.95	7.15	7.25
16	3.1	4.3	[a]5.8	7.4	12.5	14.1	8.35	6.6	6.55	6.9	7.15	7.1
17	3.7	4.3	6.4	7.45	12.75	14.6	8.55	6.55	6.5	6.85	7.15	6.95
18	3.8	4.25	6.35	7.6	12.6	14.8	8.5	6.45	6.6	6.8	7.1	6.95
19	3.9	4.2	5.9	7.6	12.1	15.2	8.55	6.45	6.9	6.8	7.0	6.9
20	4.2	4.1	5.8	7.6	11.9	15.4	8.65	6.25	6.7	6.75	6.9	6.9
21	4.15	4.2	5.9	7.9	12.3	15.0	8.75	6.2	6.6	6.7	6.85	6.9
22	4.5	[a]4.2	5.9	8.1	12.75	15.0	8.6	6.1	6.75	6.7	6.85	6.85
23	4.4	4.2	5.8	[a]8.4	13.4	14.35	8.55	6.3	7.2	6.7	6.9	6.75
24	4.3	4.2	5.8	8.8	13.7	13.8	8.35	6.6	7.0	6.65	6.85	6.65
25	4.4	4.3	5.8	8.9	14.2	13.1	8.15	6.2	6.9	6.6	6.85	6.55
26	4.5	4.3	6.5	9.2	14.2	12.4	8.05	6.2	7.0	6.6	[a]6.85	6.45
27	4.4	4.3	6.4	9.8	14.55	11.85	7.85	[a]6.25	7.0	6.55	6.85	6.4
28	4.15	4.4	6.3	10.4	14.5	11.6	7.65	6.35	[a]7.2	6.6	6.9	6.4
29	4.4	......	6.55	10.3	[a]14.2	11.2	7.55	6.45	7.4	6.75	6.9	6.5
30	4.4	......	7.3	10.0	13.9	10.6	7.55	6.5	7.6	[a]6.75	6.8	6.55
31	4.3	......	7.75	......	13.4	......	[a]7.5	[a]6.5	......	6.75	......	6.5

[a] Estimated.

Daily discharge, in second-feet, of Colorado River at Hardyville, Ariz., for 1905–6.

Day.	Jan	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1						73,460	45,260	14,080	7,160	9,290	5,650	29,500
2						70,700	44,020	14,080	7,160	11,600	5,700	26,500
3						67,090	43,200	15,090	5,970	15,900	6,000	18,200
4						63,550	40,750	16,110	5,970	13,100	5,750	14,300
5						64,430	39,940	18,950	7,460	18,200	5,800	11,500
6						73,920	37,120	17,500	8,065	15,600	5,500	10,400
7						80,010	35,120	15,430	7,760	15,300	6,000	10,200
8						85,780	32,750	15,430	8,370	14,300	8,500	9,500
9						91,700	30,400	16,460	7,760	14,000	7,200	8,800
10						98,780	30,410	14,750	8,370	12,000	7,000	7,400
11					31,580	97,760	28,850	14,080	10,850	10,300	6,000	6,300
12					31,970	91,700	26,160	12,770	8,980	8,900	6,500	6,300
13					32,350	97,760	25,000	12,440	7,760	7,900	6,200	6,700
14					33,910	99,290	23,840	11,800	7,760	7,200	5,200	6,700
15					33,940	99,800	18,950	10,850	7,460	6,200	6,700	6,000
16					32,360	92,700	23,840	10,850	7,460	6,000	6,100	6,000
17					30,110	87,740	21,180	10,220	7,160	5,300	5,800	6,000
18					31,190	82,880	19,690	9,610	6,560	5,600	5,900	6,000
19					32,360	80,010	19,320	9,600	5,970	5,600	5,980	5,300
20					32,750	77,180	18,950	9,600	5,970	5,200	6,000	5,300
21					35,520	73,920	18,220	9,290	5,090	4,850	5,400	5,600
22					41,560	69,340	18,220	9,290	5,090	4,800	5,500	6,000
23					47,330	64,430	18,220	8,370	4,810	4,800	5,600	6,700
24					53,230	61,800	17,150	8,370	5,090	5,050	6,350	6,700
25					56,640	58,790	16,460	8,370	4,515	4,700	5,760	6,700
26					62,680	57,500	15,430	15,770	4,515	5,400	17,800	7,800
27					67,090	53,230	15,430	8,980	4,515	5,050	17,300	7,400
28					70,700	49,810	15,430	7,160	4,515	5,700	14,500	7,400
29					81,920	50,680	15,430	6,560	10,510	6,050	13,200	7,400
30					79,060	54,080	15,090	7,160	10,540	5,900	13,300	6,700
31					76,240	....	14,750	7,160	......	5,900	....	6,700
1906.												
1	3,430	6,100	6,700	33,600	45,900	83,500	62,600	25,000	15,500	17,800	8,300	7,720
2	3,000	5,600	6,000	36,900	42,900	91,700	59,000	25,000	13,200	16,000	8,000	6,800
3	3,100	5,200	6,000	32,800	41,800	95,500	55,000	29,000	12,500	17,500	8,600	6,700
4	2,900	5,250	5,700	27,300	41,300	94,300	51,000	27,000	13,500	16,800	9,470	6,000
5	2,850	5,110	5,700	27,100	36,400	95,000	50,500	24,400	13,000	16,600	8,900	5,500
6	3,100	5,000	5,650	23,600	31,000	96,500	47,500	21,500	13,000	15,800	9,200	6,000
7	3,440	5,300	5,600	21,100	31,000	94,500	48,700	18,500	12,200	13,500	9,500	10,100
8	3,150	5,300	5,700	21,500	28,500	93,200	47,000	20,700	13,600	12,800	9,500	23,100
9	3,050	5,700	5,650	21,300	35,600	91,200	47,500	18,800	13,600	12,100	10,000	11,500
10	3,300	6,100	5,600	22,100	42,500	92,000	44,100	19,100	13,600	11,700	12,800	13,000
11	3,200	6,200	5,700	22,800	52,700	93,200	41,000	20,500	12,000	12,000	12,700	12,600
12	3,250	6,400	5,800	22,900	58,500	95,800	39,600	17,800	12,600	12,300	12,500	12,400
13	3,200	6,200	6,700	27,000	65,800	91,000	39,000	18,000	12,100	12,000	12,200	11,700
14	3,500	6,200	7,500	26,100	72,800	100,000	31,500	17,500	12,100	12,000	11,300	11,300
15	3,450	6,000	10,600	24,600	71,500	100,000	31,600	17,200	12,100	11,700	10,700	11,300
16	3,700	6,050	15,000	25,200	77,100	101,000	33,500	17,300	11,700	11,100	10,600	10,100
17	4,500	6,100	19,300	25,700	78,000	105,000	36,000	17,600	11,300	10,800	10,300	9,100
18	4,800	5,900	19,000	27,200	72,300	110,000	35,700	16,200	12,000	10,300	10,200	9,100
19	5,200	5,800	15,400	27,200	68,000	115,000	36,500	16,500	15,000	10,200	9,600	9,000
20	5,700	5,600	14,300	27,300	63,700	116,000	37,200	14,000	12,500	9,810	9,200	9,000
21	5,900	5,850	14,900	30,200	68,500	113,000	39,700	13,500	10,800	9,800	9,000	9,000
22	7,300	5,900	14,300	32,200	73,500	113,000	38,500	12,500	11,800	9,300	9,200	8,900
23	7,000	6,000	13,500	34,100	81,000	106,000	38,000	15,000	16,500	9,200	9,400	8,300
24	6,700	6,050	13,200	37,100	83,000	100,000	35,700	20,300	11,000	8,900	9,430	7,600
25	7,200	6,350	12,800	38,300	89,500	93,000	33,600	14,200	12,500	8,500	9,200	7,000
26	7,700	6,300	18,000	41,700	89,500	85,000	32,600	14,000	13,000	8,450	9,200	6,700
27	7,300	6,300	17,600	48,600	92,200	79,700	30,500	14,100	13,000	8,200	9,200	6,400
28	7,700	6,700	17,200	55,600	93,000	76,700	28,500	15,000	15,000	8,400	9,500	6,100
29	7,200	......	22,300	54,500	91,000	72,500	27,600	16,500	17,400	9,400	9,500	7,160
30	7,100	......	26,800	51,200	89,000	66,000	27,500	16,500	19,500	9,400	8,800	7,400
31	6,700	......	31,800	....	84,500	....	27,500	16,500	......	9,400	....	7,700

NOTE.—These discharges were obtained by the indirect method for shifting channels, except from May 11 to October 1, 1905, when a rating table was used.

Estimated monthly discharge of Colorado River at Hardyville, Ariz., for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.				
May (11 to 31)	81,920	30,410	47,370	1,973,000
June	99,800	49,840	75,760	4,508,000
July	45,260	14,750	25,310	1,556,000
August	18,950	6,560	11,810	726,200
September	10,850	4,515	6,972	414,900
October	18,200	4,700	8,571	527,000
November	17,800	5,200	7,606	452,600
December	29,500	5,300	9,097	559,400
The period				10,720,000
1906.				
January	7,700	2,850	4,830	297,000
February	6,700	5,000	5,880	327,000
March	31,800	5,600	12,300	756,000
April	55,600	21,100	31,600	1,880,000
May	93,000	28,500	64,500	3,970,000
June	116,000	66,000	95,300	5,670,000
July	62,600	27,500	40,000	2,460,000
August	29,000	12,500	18,400	1,130,000
September	19,500	10,800	13,400	797,000
October	17,800	8,200	11,700	719,000
November	12,800	8,000	9,870	587,000
December	23,100	5,500	9,260	569,000
The year	116,000	2,850	26,400	19,200,000

NOTE.—Values are rated as follows: October to December, 1905, fair; remainder of 1905 and 1906, good.

COLORADO RIVER AT YUMA, ARIZ.

This station is located in the town of Yuma, Ariz., 1½ miles below the mouth of Gila River and 10 miles, by river, above the Mexican boundary. Records of river height have been kept by the Southern Pacific Company since April 1, 1878, on the gage which was established by Arthur Brown, superintendent of the company's bridge and building department, during the summer of 1876. The conditions at the station and the bench marks are described in Water-Supply Paper No. 177, page 13, where are given also references to publications that contain data for previous years.

Discharge measurements of Colorado River at Yuma, Ariz., in 1906.

[BY W. D. SMITH AND OTHERS.]

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 3	17.70	5,730	February 21	19.40	10,800
January 5	17.55	5,580	February 24	19.30	10,200
January 9	17.45	5,090	March 6	18.90	8,600
January 13	17.40	4,550	March 9	18.90	7,730
January 19	17.40	4,260	March 12	18.85	6,740
January 23	19.50	16,100	March 15	26.35	54,300
January 25	19.60	13,800	March 16	27.55	66,700
January 27	18.80	10,000	March 17	24.75	42,300
January 30	18.70	9,740	March 19	22.75	33,200
February 2	18.55	9,110	March 21	22.05	24,600
February 5	18.20	7,280	March 24	21.50	22,400
February 9	18.20	6,360	March 27	24.00	43,800
February 12	18.55	8,220	March 28[a]	26.50	65,600
February 15	18.90	9,640	March 29[a]	28.10	75,000
February 16	19.95	14,600	March 31[a]	23.70	34,700
February 19	19.60	12,200	April 3	23.80	37,500

[a] Measured by J. N. Johannson.

Discharge measurements of Colorado River at Yuma, Ariz., in 1906—Continued.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
April 5	23.40	37,800	August 27	19.10	15,200
April 9	22.30	27,200	August 29	19.50	16,400
April 11	22.70	29,800	August 31	18.90	13,400
April 14	22.45	27,800	September 3	19.20	14,500
April 16	22.70	29,500	September 5	18.85	12,500
April 18	22.40	27,200	September 7	18.70	12,000
April 20	22.45	26,100	September 10	18.75	11,800
April 23	22.65	29,000	September 13	18.80	11,800
April 25	23.10	31,700	September 15	18.70	10,700
April 27	23.55	36,700	September 17	16.65	10,700
April 30	24.50	44,100	September 19	18.40	9,920
May 2	25.10	50,800	September 21	18.40	10,200
May 5	24.55	40,600	September 24	18.40	10,300
May 8	24.30	36,800	September 26	19.10	13,200
May 10	23.70	35,100	September 28	18.70	11,700
May 12	24.25	42,100	October 1	19.55	15,900
May 15	24.90	46,500	October 3	19.40	14,700
May 18	26.20	52,800	October 6	19.35	15,800
May 21	27.10	64,200	October 8	19.10	14,900
May 24	27.20	68,900	October 10	18.80	14,300
May 28	27.60	71,100	October 11	18.60	13,300
June 1	28.60	81,800	October 16	18.10	10,700
June 5	28.30	92,400	October 18	18.10	10,800
June 8	27.40	89,000	October 22	18.00	9,950
June 11	27.30	82,100	October 24	18.00	9,800
June 13	26.90	65,800	October 27	18.00	8,980
June 16	26.95	80,600	October 29	18.05	8,610
June 18	26.90	80,800	November 1	18.35	8,630
June 21	26.75	79,800	November 3	18.50	9,150
June 23	27.30	83,000	November 6	18.65	8,430
June 25	27.80	96,600	November 8	18.75	9,420
June 28[a]	28.05	96,900	November 9	18.75	9,430
June 30	27.30	80,300	November 10	18.80	9,650
July 3	24.35	60,400	November 12	19.20	11,600
July 5	22.85	48,100	November 14	19.10	11,500
July 9	21.85	40,400	November 16	19.00	10,800
July 11	21.80	38,600	November 20	18.95	10,000
July 13	21.40	38,100	November 22	18.75	9,280
July 16	20.95	35,100	November 24	18.80	9,230
July 18	21.15	32,900	November 26	18.80	8,670
July 20	21.30	32,400	November 28	18.80	9,210
July 23	21.60	31,600	December 1[b]	18.70	9,080
July 25	21.40	33,000	December 3	18.65	9,080
July 28	21.10	29,100	December 5	18.50	8,470
July 30	20.70	29,100	December 6	21.10	26,000
August 1	20.35	25,600	December 8	23.90	47,000
August 4	20.00	24,500	December 10	21.90	37,000
August 7	19.70	21,900	December 11	21.00	28,200
August 9	19.30	22,000	December 12	20.30	23,400
August 11	19.55	20,500	December 15	19.60	18,300
August 13	19.40	19,500	December 17[c]	19.30	15,800
August 15	19.20	16,900	December 19	19.10	13,900
August 18	19.10	16,500	December 21	18.90	12,300
August 20	19.25	16,400	December 24	18.80	11,300
August 21	19.90	18,500	December 26	18.60	10,600
August 24	19.20	15,500	December 28	18.50	8,570
August 25	19.80	17,900	December 29	18.50	8,940

[a] Measurements June 28 to July 25 by F. R. S. Buttemer.
[b] Measurements December 1 to 15 by J. M. Brown.
[c] Measurements December 17 to 29 by L. C. Robertson.

Daily gage height, in feet, of Colorado River at Yuma, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	17.75	18.6	19.0	24.2	24.75	28.6	26.5	20.35	18.8	19.55	18.35	18.7
2	17.7	18.55	19.0	23.9	25.1	28.8	25.55	20.3	19.0	19.4	18.5	18.8
3	17.7	18.55	19.0	23.8	25.0	28.8	24.35	20.2	19.2	19.4	18.5	18.65
4	17.6	18.45	19.0	24.0	24.7	28.6	23.35	20.0	19.1	19.45	18.6	18.6
5	17.55	18.2	18.95	23.4	24.55	28.3	22.85	20.15	18.85	19.45	18.6	18.5
6	17.4	18.3	18.9	23.2	24.55	27.95	22.4	20.0	18.7	19.35	18.65	20.3
7	17.4	18.2	18.95	22.95	24.4	27.6	22.0	19.7	18.7	19.15	18.7	25.3
8	17.5	18.2	18.95	....	24.2	27.4	21.9	19.4	18.7	19.1	18.75	23.55
9	17.45	18.2	18.9	22.45	23.95	27.4	21.85	19.3	18.65	18.9	18.8	21.2
10	17.5	18.2	18.85	22.9	23.8	27.45	21.85	19.2	18.75	18.8	18.8	22.1

Daily gage height, in feet, of Colorado River at Yuma, Ariz., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	17.5	18.7	18.85	22.7	23.8	27.3	21.8	19.55	18.8	18.6	18.85	20.9
12	17.5	18.55	18.85	22.65	24.25	27.1	21.55	19.4	18.85	18.4	19.2	20.3
13	17.4	18.7	18.9	22.6	24.3	26.9	21.4	19.4	18.8	18.25	19.3	20.05
14	17.4	18.8	20.2	22.45	24.5	26.7	21.3	19.4	18.8	18.25	19.1	19.8
15	17.4	18.9	26.2	22.9	24.9	26.75	21.1	19.2	18.7	18.2	19.1	19.5
16	17.4	19.95	27.55	22.7	25.4	26.95	20.95	19.2	18.7	18.1	19.0	19.3
17	17.4	20.0	25.5	22.4	25.85	26.95	20.95	19.1	18.65	18.1	18.95	19.3
18	17.4	19.8	23.2	22.4	26.2	26.9	21.25	19.1	18.6	18.1	18.9	19.15
19	17.4	19.6	22.65	22.55	26.45	26.8	21.5	19.5	18.4	18.1	18.9	19.05
20	17.45	19.4	22.85	22.45	26.8	26.7	21.2	19.25	18.35	18.0	18.9	19.01
21	17.4	19.4	22.05	22.4	27.1	26.75	21.35	19.9	18.45	18.0	18.9	18.9
22	17.5	19.4	21.7	22.4	27.2	26.85	21.5	19.3	18.6	18.0	18.8	19.0
23	19.5	19.3	21.6	22.7	27.3	27.3	21.6	19.25	18.6	18.0	18.8	18.9
24	19.4	19.3	21.5	22.9	27.2	27.6	21.5	19.2	18.4	18.0	18.8	18.8
25	19.6	19.2	21.35	23.1	27.2	27.8	21.4	19.8	18.7	17.95	18.8	18.7
26	19.0	19.1	21.2	23.5	27.3	27.85	21.4	19.45	19.1	17.95	18.8	18.6
27	18.8	19.0	23.1	23.55	27.5	28.10	21.2	19.15	18.8	18.0	18.75	18.5
28	18.75	19.0	26.0	23.8	27.6	28.05	21.1	18.9	18.7	18.0	18.8	18.5
29	18.75	....	27.95	24.2	27.8	27.85	20.9	19.5	18.8	18.05	18.75	18.5
30	18.7	....	25.0	24.5	28.2	27.3	20.7	19.2	19.0	18.1	18.8	18.4
31	18.7	....	23.8	....	28.4	....	20.5	18.9	....	18.15	....	24.55

Daily discharge, in second-feet, of Colorado River at Yuma, Ariz., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5,860	9,280	9,350	39,600	46,900	81,800	74,200	25,600	12,700	15,900	8,630	9,080
2	5,800	9,100	9,210	37,600	50,800	84,000	68,000	25,500	13,300	15,000	9,300	9,080
3	5,730	9,000	9 0 0	37,500	48,600	84,200	60,400	25,200	14,500	14,700	9,150	9,080
4	5,640	8,500	8,900	38,000	43,400	87,200	52,200	24,500	13,800	15,100	9,270	9,000
5	5,580	7,280	8,750	37,800	40,600	92,400	48,100	24,900	12,500	15,200	8,700	8,470
6	5,400	7,500	8,600	35,900	41,000	91,100	44,600	24,400	12,100	15,800	8,430	17,800
7	5,280	6,800	8,350	33,400	38,500	89,800	41,900	21,900	12,000	15,000	9,000	60,000
8	5,230	6,600	8,0 0	31,000	36,800	89,000	41,100	21,900	11,900	14,900	9,420	43,900
9	5,090	6,360	7,730	27,200	35,000	86,700	40,400	22,000	11,900	14,500	9,700	27,900
10	4,950	6,450	7,300	32,200	35,100	85,300	39,500	21,900	11,800	14,300	9,650	38,700
11	4,830	8,860	6,900	29,800	36,700	82,100	38,600	20,500	11,800	13,300	9,800	27,400
12	4,700	8,220	6,740	29,200	42,100	74,000	40,600	19,700	11,900	11,800	11,600	23,400
13	4,550	8,840	7,000	29,000	42,800	65,800	38,100	19,500	11,800	10,900	12,500	21,600
14	4,500	9,250	15,600	27,800	44,000	65,000	37,400	19,200	11,700	10,800	11,500	19,800
15	4,450	9,640	54,300	31,200	46,500	70,000	36,300	16,900	10,700	10,500	11,500	17,500
16	4,400	14,600	66,700	29,500	48,900	80,600	35,400	16,800	10,700	10,700	11,400	15,900
17	4,350	14,800	42,300	27,200	51,100	80,600	34,600	16,600	10,700	10,800	10,500	15,800
18	4,300	13,500	35,000	27,200	52,800	80,800	32,900	16,500	10,500	10,800	10,200	14,500
19	4,250	12,200	33,200	28,200	55,900	80,400	32,600	17,500	9,900	10,700	9,900	13,800
20	4,600	11,000	33,500	26,100	60,200	80,100	32,400	16,400	9,600	10,300	9,750	13,200
21	4,400	10,800	24,600	25,800	64,200	79,800	32,200	18,500	10,200	10,100	9,850	12,300
22	5,000	10,700	23,300	25,500	66,000	80,400	31,800	18,100	10,900	10,000	9,300	12,800
23	16,100	10,300	22,800	29,000	67,700	83,000	31,600	15,800	11,000	9,800	9,330	12,900
24	14,000	10,200	22,400	30,600	68,900	91,000	32,300	15,500	10,300	9,800	9,230	11,300
25	13,800	9,880	21,200	31,700	69,200	96,600	33,000	17,900	11,500	9,500	8,900	11,000
26	11,000	9,550	19,000	36,200	69,700	96,400	32,400	16,400	13,200	9,200	8,670	10,600
27	10,000	9,250	43,800	36,700	70,600	99,200	30,800	15,200	12,100	9,000	8,700	9,500
28	9,940	9,190	65,600	38,600	71,200	97,100	29,100	14,300	11,700	8,800	9,210	8,870
29	9,830	....	75,000	41,800	73,500	92,000	29,100	16,400	12,200	8,600	9,000	8,000
30	9,740	....	47,500	44,100	77,300	79,300	29,100	15,000	13,300	8,600	9,080	6,800
31	9,600	....	34,700	....	79,800	....	27,000	13,400	....	8,600	....	48,900

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Colorado River at Yuma, Ariz., for 1906.

[Drainage area, 225,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	16,100	4,260	6,870	422,000	0.030	0.03
February	14,800	6,360	9,560	531,000	0.042	.04
March	75,000	6,740	25,400	1,560,000	0.113	.13
April	44,100	25,500	32,500	1,930,000	0.144	.16
May	79,800	35,100	54,100	3,330,000	0.240	.28
June	99,200	65,000	84,200	5,010,000	0.374	.42
July	74,200	27,000	39,000	2,400,000	0.173	.20
August	25,600	13,400	19,200	1,180,000	0.085	.10
September	14,500	9,600	11,700	696,000	0.052	.06
October	15,900	8,600	11,700	719,000	0.052	.06
November	12,500	8,430	9,710	578,000	0.043	.05
December	60,000	6,800	18,300	1,130,000	0.081	.09
The year	99,200	4,260	26,900	19,490,000	0.119	1.62

NOTE.—These values are good.

MISCELLANEOUS MEASUREMENTS IN COLORADO RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in Colorado River drainage basin below Hardyville in 1906:

Colorado River below heading No. 3 of Imperial canal.—Measurements at this point show the discharge in the old channel of Colorado River below the intake of the Imperial canal, where most of the flow was diverted into Salton Sea.

There was practically no discharge in the old channel from early in July until the closure of the break, in November, 1906. The conditions at this point are described in Water-Supply Paper No. 177, page 17.

Discharge measurements of Colorado River below heading No. 3 of Imperial canal in 1906.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer	Gage height.	Discharge.
		Feet.	*Sec.-ft.*			*Feet.*	*Sec.-ft.*
April 10	W. D. Smith	4.90	1,700	June 7	W. D. Smith	7.00	3,210
April 24	do	4.60	974	June 19	do	6.30	398
May 1	do	5.60	2,040	June 27	Smith and Buttemer.	7.10	[a] 1,220
May 14	do	5.10	1,040	July 4	F. R. S. Buttemer.	4.50	34
May 22	do	6.70	3,840	July 11	do	3.80	0
May 29	do	6.80	3,440				

[a] Second channel estimated.

Farmer's canal near Yuma, Ariz.—This canal diverts water from Colorado River about 1 mile below Yuma. Measurements were made at the heading. The canal was dry after July 4.

June 7: Area, 82 square feet; discharge, 58 second-feet.

June 19: Area, 78 square feet; discharge, 48 second-feet.

Ludy canal near Yuma, Ariz.—This canal diverts water from Colorado River about 3 miles below Yuma. Measurements were made at the heading. The canal was dry after July 4.

June 7: Area, 109 square feet; discharge, 76 second-feet.

June 19: Area, 116 square feet; discharge, 93 second-feet.

SALTON SEA NEAR SALTON, CAL.

What is now generally known as Salton Sea was until recently an old dry lake or playa, marked on maps as Salton Sink. There is some uncertainty as to the elevation of the lowest point of this sink, and it is now believed that the depth below sea level has been overestimated in the past. From the record of the depth of the water as it filled the lowest portion of the basin, as kept by the New Liverpool Salt Company, it appears that the maximum depth of water was 17 feet on October 4, 1905 (according to the gage and as checked by soundings later), when on the same date the water surface just covered the United States Geological Survey bench mark a few feet from the old Salton railway station. As this bench mark is 256.5 feet below mean sea level, it would appear that the lowest point of the sink is 273.5 feet below mean sea level instead of 287 feet, which has been accepted heretofore.

Salton Sink originally formed a part of the Colorado Desert, which has an area of nearly 2,000 square miles and extends in a northwesterly direction almost 100 miles from the California-Mexico boundary line. It comprises two fertile valleys, that to the northwest of the sink, in Riverside County, being known as the Coahuila Valley, and the one to the southeast of the sink, in San Diego County, being called the Imperial Valley. Salton Sea, which now partly fills the sink, separates the two valleys and is partly in Riverside County and partly in San Diego County. The longest diameter of the sea has a northwest-southeast direction. On December 31, 1906, its surface was 201 feet below mean sea level and it had a length of nearly 50 miles, a maximum width of about 16 miles, a minimum width of 10 miles, a maximum depth of 72.5 feet, and a superficial area of about 462 square miles. It is about 160 miles southeast of Los Angeles, 90 miles northwest of Yuma, and 50 miles north of Calexico.

A few thousand years ago, according to geologic evidence, what is now Salton Sea was a part of the Gulf of California, which then extended about 200 miles further northwest than at present, reaching possibly to the base of San Jacinto and San Gorgonio mountains, and certainly some distance beyond the present town of Indio. Colorado River then emptied into the Gulf about 125 miles below its head in the vicinity of Yuma, 75 miles above the present mouth. The river, then as now, was heavily laden with silt, at present estimated to amount to about 53 mile-feet annually, or sufficient to cover 53 square miles 1 foot deep each year. The checking of the velocity near the river's mouth owing to the practically still water of the Gulf, resulted in a deposition of this vast volume of silt, and in the course of hundreds of years built up a broad delta that extended westward as a wide bar or dam until it eventually reached the Cocopa Mountains in Mexico, the western wall of the valley, forming an inland salt, or brackish, sea. During the next few hundred years the Colorado delivered all, or a part, of its silt-laden waters into this newly formed sea, raising the level of its waters coincidently with elevating, broadening, and strengthening by the silt-depositing process the barrier dam which effected its complete and permanent isolation. In the course of many years the dam and the level of the inland sea reached a height of about 30 feet above mean sea level, whereupon the river took a course of less resistance and found an outlet to the Gulf below the recently completed dam.

Whether the river maintained its outlet to the Gulf continuously until the inland sea was completely dissipated through the medium of evaporation is not known. The probability is that the river followed the course of all rivers with growing deltas, and changed its channel from time to time with more or less caprice, alternately discharging into the Gulf and the inland sea. At any rate it is definitely known from the shells found on the desert that the water which ultimately filled the inland sea was fresh, while the originally isolated Gulf water was salt. The conversion from salt to fresh water may have come about through the alternate partial evaporation of the salt water and the refilling with fresh water from the river, or it may have been effected gradually by means of dilution and substitution from a continuous fresh-water inflow covering a long period of time.

As to the date when this inland sea finally disappeared there is no definite information. The Indians now living in the desert are said to have a tradition that the sea was full as late as 400 or 500 years ago at most, and that the water disappeared "poco a' poco"—little by little—until the sea became dry. The geologic evidence at hand neither confirms nor disproves the Indian legend, but simply indicates that the dissipation of the sea occurred at a time which, if not historic, is at least one of the most recent of geologic dates. With climatic conditions as they are at present the sea when full would probably have evaporated in 50 years if not checked by inflow. It is highly probable that the sink has been partly refilled many times in the recent past, the water soon evaporating. During the summer of 1891 the high water in the Colorado overflowed into the sink to such an extent as to endanger the Southern Pacific's railway at its lowest point. In the summer of 1905, after a succession of winter and spring floods in Gila River, followed by an exceptionally heavy summer flow in the Colorado, there was a repetition of flood conditions in the sink on a much larger scale.

The gravity of the situation on this latter date, however, was greatly augmented by the interference of man. For several years preceding a small quantity of water had been diverted from the Colorado below Yuma, Ariz., to be used by the settlers of the Imperial Valley for irrigation and domestic purposes. The first water was diverted in the United States and conveyed to the Imperial Valley, after passing through Mexican territory, by means of an old river channel which had been one of the Colorado's distributaries during the formation of its delta, and is now known as Alamo River. The increased demand for water and the silting up of the original canal heading above the boundary line necessitated the cutting of an additional channel from the river below the boundary to connect with the canal. It likewise silted up, so that in order to supply the urgent need for water a canal was cut 4 miles below the original heading to connect Colorado and Alamo rivers. This canal was not provided with protective headworks and had a gradient much greater than that of the river, so that with the unusual and prolonged summer flood in 1905, it began cutting, until in July it was carrying 87 per cent of the total flow of the river. This large quantity of water flooded several hundred square miles about Calexico in the southern part of the Imperial Valley, and caused serious loss both in the United States and in Mexico. These waters ultimately reached the Salton Sea but in doing so they deepened and widened Alamo River into a great gorge and developed another drainage channel to the west through Imperial Valley in a second gorge now called New River. Notwithstanding all attempts to control it the Colorado continued to pour its waters through Alamo and New rivers into Salton Sea until the early fall of 1906 when it was finally shut off by the Southern Pacific Company. It broke again, however, on December 7, but was closed about two months later.

The rise of Salton Sea began in November, 1904, and continued throughout 1905 and 1906. In the summer of 1905 it endangered the Southern Pacific tracks to such an extent as to require frequent shifting to higher ground by means of "shoo-fly" or spur tracks, which served temporarily until the latter part of the year when a high line about 40 miles in length was completed on the 200-foot contour below sea level. This line is still in use, though during the latter part of 1906 the lowest portion of it was seriously damaged by the action of waves. For use in the future, if required, another line has been located and graded on the 150-foot contour below sea level. In addition to the damage done to the railroad the sea has completely submerged the plant of the New Liverpool Salt Company, below Mecca, and also a few ranches in the vicinity of Mecca.

The gage record from November, 1904, to February 26, 1906, was kept by the New Liverpool Salt Company. Their datum is the lowest portion of the sink, or at least that portion which first filled with water, so that the gage record shows the actual depth of the water from time to time. On February 23, 1906, the government put in a gage on the same datum about one-half mile west of Salton railway station, which is 3 miles southeast of the old Salton station. This gage consisted of a series of 5 posts, 6 inches by 6 inches by 6 feet, set in the ground about 3 feet deep, and so placed that when the water covered one it would just reach the next one farther back. It was not a great while, however, until the waves completely destroyed this gage. In the meantime the Southern Pacific Company had graduated a bent on the trestle bridge across Salt Creek, about 2½ miles east of Salton, using the company's datum, and arrangements were made to have the Southern Pacific agent at Salton furnish the record from this gage, corrections being made to reduce to the original datum. The zero of the gage is 273.5 feet below mean sea level as determined from United States Geological Survey bench marks, or at an elevation of -280.3 according to the Southern Pacific Company.

Daily gage height, in feet, of Salton Sea near Salton, Cal., for 1904–1906.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1904.			1904.			1904.		
1	0.0	0.6	13	0.0	0.7	25	0.4	0.6
2	.0	.6	14	.0	.7	26	.4	.1
3	.0	.6	15	.2	.7	27	.5	.0
4	.0	.6	16	.2	.7	28	.5	.8
5	.0	.2	17	.3	.7	29	.6	.8
6	.0	.0	18	.3	.7	30	.6	.8
7	.0	.3	19	.3	.7	31	...	.8
8	.0	.7	20	.4	.7			
9	.0	.7	21	.5	.7	Total monthly rise	.6	.2
10	.0	.7	22	.5	.7			
11	.0	.7	23	.4	.7			
12	.0	.7	24	.4	.6			

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1	0.8	2.2	3.8	4.8	5.7	7.0	9.1	13.5	15.7	16.8	18.3	19.8
2	.7	2.2	3.9	4.8	5.8	7.1	9.2	13.8	15.7	16.9	18.3	19.8
3	.6	2.3	4.0	4.8	5.9	7.0	9.4	13.8	15.7	16.9	18.4	19.9
4	.6	2.4	4.2	4.9	6.0	7.1	9.6	13.8	15.7	17.0	18.5	19.9
5	.6	2.4	4.4	5.0	5.8	7.2	9.7	13.8	15.7	17.0	18.5	20.0
6	.7	2.4	4.4	5.2	5.8	7.3	9.8	13.8	15.8	17.1	18.6	20.1
7	.7	2.5	4.4	5.3	6.2	7.6	10.1	14.0	15.8	17.1	18.7	20.2
8	.8	2.6	4.4	5.2	6.1	7.2	10.2	14.1	15.8	17.1	18.8	20.3
9	.8	2.7	4.4	5.4	6.0	7.3	10.3	14.2	15.8	17.1	18.8	20.5
10	.9	2.8	4.3	5.2	5.8	7.6	10.3	14.2	15.9	17.2	18.8	20.7
11	1.0	2.8	4.3	5.2	6.2	7.5	10.7	14.2	15.9	17.2	18.8	20.8
12	1.0	2.8	4.3	5.3	6.2	7.7	10.8	14.4	16.0	17.2	18.9	21.0
13	1.1	2.9	4.3	5.4	6.2	7.7	10.9	14.3	16.0	17.2	19.0	21.2
14	1.1	3.0	4.2	5.5	6.3	7.7	10.9	14.4	16.1	11.2	19.0	21.3
15	1.1	3.2	4.2	5.4	6.3	7.8	11.1	14.5	16.1	17.3	19.1	21.5
16	1.7	3.2	4.2	5.5	6.4	7.8	11.2	14.6	16.2	17.3	19.2	21.7
17	1.8	3.2	4.6	5.3	6.4	7.8	11.4	14.7	16.2	17.4	19.2	21.8
18	1.8	3.2	4.6	5.5	6.4	7.8	11.7	14.8	16.2	17.5	19.2	21.9
19	1.8	3.3	4.6	5.2	6.5	8.0	11.9	14.8	16.2	18.0	19.2	22.0
20	1.8	3.3	4.5	5.5	6.6	8.0	11.9	14.9	16.3	17.7	19.3	22.1
21	1.8	3.4	4.5	5.4	6.5	8.2	12.1	15.0	16.3	17.8	19.3	22.2
22	1.8	3.4	4.5	5.7	6.7	8.2	12.2	15.0	16.4	17.8	19.4	22.2
23	1.8	3.4	4.6	5.7	6.5	8.3	12.4	15.1	16.4	17.9	19.4	22.3
24	1.9	3.4	4.6	5.7	6.8	8.4	12.5	15.2	16.5	17.9	19.5	22.3
25	2.0	3.5	4.6	5.5	6.6	8.5	12.7	15.2	16.5	18.0	19.5	22.4
26	2.0	3.6	4.6	5.6	6.6	8.5	12.8	15.3	16.6	18.0	19.6	22.4
27	2.0	3.7	4.6	5.7	6.6	8.7	13.0	15.4	16.7	18.1	19.7	22.5
28	2.0	3.8	4.7	5.8	6.8	8.8	13.1	15.5	16.8	18.2	19.7	22.6
29	2.1	.....	4.6	5.8	6.8	8.8	13.2	15.5	16.8	18.2	19.8	22.6
30	2.1	.....	4.6	5.8	7.0	9.0	13.2	15.6	16.8	18.2	19.8	22.7
31	2.2	.....	4.6	.....	6.8	.....	13.4	15.6		18.2	....	22.7
Total monthly rise	1.4	1.6	.8	1.2	1.0	2.2	4.4	2.2	1.2	1.4	1.6	2.9

Google

Daily gage height, in feet, of Salton sea near Salton, Cal., for 1904–1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
1	22.8	23.9	......	28.3	34.1	42.7	59.1	66.7	69.5	70.3	71.5	71.3
2	22.8	24.0	25.6	......	......	43.3	59.4	66.9	69.5	70.3	71.5	71.3
3	22.8	24.0	......	28.7	34.4	43.8	60.1	67.0	69.6	70.3	71.5	71.2
4	22.8	24.2	......	......	34.5	44.4	60.3	67.0	69.6	70.4	71.5	71.2
5	22.9	24.2	25.8	29.1	......	44.7	60.5	67.1	69.7	70.4	71.6	71.2
6	22.9	24.3	......	......	......	......	61.0	67.2	69.8	70.4	71.6	71.2
7	23.0	24.4	25.9	29.5	......	......	61.4	67.3	69.9	70.4	71.6	71.2
8	23.0	24.4	26.0	29.7	......	......	61.7	67.4	69.9	70.6	71.6	71.2
9	23.1	24.5	......	......	......	......	62.1	67.5	69.9	70.6	71.6	71.2
10	23.1	24.5	26.0	30.2	......	47.9	62.3	67.6	69.9	70.8	71.6	71.2
11	23.2	24.7	......	......	......	48.4	62.6	67.7	69.9	70.9	71.6	71.2
12	23.2	24.8	26.0	30.5	36.4	48.6	62.8	67.8	70.0	71.1	71.6	71.2
13	23.2	24.8	26.2	30.9	......	49.5	63.3	67.9	70.0	71.3	71.6	71.4
14	23.2	24.9	......	31.1	36.9	50.0	63.3	68.1	70.0	71.3	71.6	71.4
15	23.3	25.0	......	31.3	37.2	......	63.5	68.2	70.1	71.3	71.6	71.5
16	23.3	25.0	......	......	......	51.3	63.8	68.3	70.1	71.3	71.5	71.5
17	23.3	25.1	26.3	31.7	37.5	......	64.1	68.4	70.1	71.3	71.5	71.5
18	23.3	25.1	26.4	......	37.8	52.3	64.3	68.5	70.1	71.3	71.5	71.6
19	23.4	25.2	26.4	32.0	38.0	......	64.4	68.6	70.1	71.3	71.5	71.7
20	23.4	25.2	......	32.2	38.4	52.8	64.6	68.7	70.1	71.3	71.5	71.8
21	23.4	25.2	26.5	32.3	......	......	64.8	68.8	70.1	71.4	71.5	71.8
22	23.5	25.3	......	......	38.9	......	65.0	68.9	70.1	71.4	71.5	71.9
23	23.6	25.4	26.8	......	......	......	65.3	69.0	70.1	71.4	71.5	72.0
24	23.5	25.5	27.0	......	39.5	......	65.3	69.0	70.1	71.4	71.5	72.1
25	23.6	25.6	27.1	33.0	39.8	55.3	65.5	69.1	70.1	71.4	71.4	72.2
26	23.6	25.7	......	......	40.0	55.7	65.7	69.2	70.2	71.4	71.4	72.3
27	23.6	......	27.6	33.3	40.7	56.2	65.9	69.3	70.2	71.4	71.4	72.3
28	23.7	......	27.7	......	41.3	56.7	66.1	69.4	70.2	71.5	71.4	72.3
29	23.7	......	......	33.6	41.5	57.3	66.2	69.4	70.2	71.5	71.3	72.4
30	23.8	......	28.2	......	41.8	57.9	66.3	69.4	70.3	71.5	71.3	72.4
31	23.8	......		..	42.5	......	66.5	69.4	......	71.5	......	72.5
Total monthly rise	1.1	1.8	2.7	5.6	8.7	15.4	8.6	2.9	.9	1.2	−.2	1.2

THE GREAT BASIN DRAINAGE.

GENERAL FEATURES.

The Great Basin drainage in California is comprised within the subdrainages Sierra Nevada and Minor Great Basin. Within the Sierra Nevada drainage is a limited area of arid country lying on the eastern slope of the Sierra Nevada. This area includes the Susan and Owens River drainage basins. Within the Minor Great Basin drainage lies the Mohave River drainage basin. Having no outlet to the sea, the entire drainage of these basins is lost mainly through evaporation from the lakes and sinks in which the waters of these rivers collect.

OWENS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Owens River has its source in the Sierra Nevada in eastern California and flows southeast parallel with this range, finally discharging its waters into Owens Lake. This basin has a length from north to south of approximately 150 miles with a width of from 20 to 25 miles. It lies between the Sierra Nevada on the west and the White

Mountains on the east. Practically the entire flow of this river is derived from the Sierra Nevada, as it drains the entire eastern slope of this range from Mount Lyell on the north to a point some distance below Mount Whitney on the south. The White Mountains furnish no water for this stream except in times of exceptionally heavy rain storms, which seldom occur on this range. There are numerous tributaries entering Owens River from the west which have their source in the high elevations of the Sierra Nevada, extending from the northern to the southern limits of this basin. The topography of the portion of the Sierra Nevada drained by this stream is extremely rough and precipitous, the mountains rising abruptly from Owens Valley to elevations of 13,000 to 14,000 feet. The formation is of granite, with very little soil covering and sparse timber growth. Numerous lakes and marshes are found in the upper reaches of this portion of the drainage basin.

Owens River, a short distance below its source, enters a flat, swampy country known as Long Valley, where a considerable quantity of its flow is used for the irrigation of meadow lands for stock raising. This water returns to the river channel at the lower end of this valley, at which point the stream enters a deep, narrow gorge with heavy grade. As the river breaks from this canyon it enters Owens Valley, through which it flows for a distance of about 80 miles, finally discharging into Owens Lake. The gaging station at Round Valley is located at the lower end of this canyon. Below this point numerous diversions are made for the irrigation of land in Owens Valley, where the soil is extensively cultivated and large areas are used for the raising of hay and grain. This country is particularly adapted to stock raising, which is carried on extensively throughout the valley. Numerous opportunities for the construction of storage reservoirs occur, both on the main stream and also on the upper reaches of its tributaries, although none have been taken advantage of as yet. The precipitation is extremely light except on the high elevations of the Sierra Nevada, where there is a heavy fall of snow. The melting of this in the spring and summer months feeds the numerous tributaries of this river, insuring a continued flow throughout the year.

OWENS RIVER NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located at the footbridge, 700 feet above the junction of Owens River and Rock Creek. The conditions at this station and the bench marks[a] are described in Water-Supply Paper No. 177, page 50, where are given also references to publications that contain data for previous years.

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[a] The elevation of the bench mark is 8.05 feet above the datum of the gage.

Discharge measurements of Owens River near Round Valley, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 8	F. R. S. Buttemer	34	73	1.75	161
January 14	do	34	77	1.92	196
January 14	do	34	79	1.93	191
August 23	Hawley and Shuey	34	111	2.85	465
November 3	G. R. Shuey	34	85	2.14	261
November 30	do	34	79	2.00	214

Daily gage height, in feet, of Owens River near Round Valley, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	1.85	1.95	2.45	2.25	2.4	3.5	3.5	2.6	2.3	2.15	2.0
2	1.8	1.9	1.95	2.4	2.3	2.45	3.55	3.5	2.6	2.3	2.15	2.0
3	1.8	1.9	1.95	2.4	2.35	2.4	3.5	3.45	2.6	2.3	2.15	2.05
4	1.8	1.9	1.95	2.4	2.3	2.45	3.45	3.45	2.6	2.35	2.15	2.1
5	1.8	1.9	1.95	2.25	2.3	2.5	(a)	3.4	2.6	2.35	2.15	2.1
6	1.8	1.9	1.95	2.1	2.25	2.6	......	3.3	2.55	2.35	2.15	2.1
7	1.75	1.9	2.0	2.15	2.2	2.7	......	3.3	2.5	2.3	2.15	2.1
8	1.75	1.9	2.0	2.3	2.25	2.9	......	3.3	2.5	2.3	2.1	2.1
9	1.75	1.95	2.0	2.5	2.2	3.9	......	3.25	2.45	2.3	2.1	2.15
10	1.75	1.95	2.0	2.6	2.25	3.95	......	3.25	2.45	2.3	2.1	2.15
11	1.8	1.95	2.1	2.7	2.35	3.0	......	3.2	2.45	2.25	2.1	2.2
12	1.8	1.95	2.3	2.7	2.5	3.25	......	3.1	2.45	2.2	2.1	2.2
13	1.9	1.95	2.25	2.75	2.45	3.3	......	3.1	2.45	2.2	2.1	2.2
14	1.9	1.95	2.2	2.7	2.4	3.4	......	3.1	2.4	2.2	2.1	2.2
15	1.9	1.95	2.2	2.65	2.4	3.4	......	3.05	2.4	2.2	2.05	2.2
16	1.9	1.95	2.25	2.7	2.4	3.45	......	3.0	2.4	2.2	2.05	2.2
17	1.95	1.95	2.25	2.7	2.4	3.45	......	2.95	2.4	2.2	2.0	2.2
18	2.15	1.95	2.25	2.7	2.45	3.5	......	2.95	2.4	2.2	2.0	2.2
19	2.1	1.95	2.3	2.7	2.6	3.55	......	3.1	2.35	2.2	2.0	2.15
20	2.0	1.95	2.3	2.7	2.65	3.6	......	3.2	2.35	2.15	2.0	2.15
21	2.0	2.0	2.35	2.6	2.6	3.7	......	3.2	2.3	2.15	2.0	2.1
22	2.1	2.0	2.35	2.6	2.55	3.75	......	3.1	2.3	2.15	2.0	2.1
23	2.1	2.0	2.35	2.5	2.5	3.85	......	2.85	2.25	2.1	2.0	2.15
24	2.1	2.0	2.4	2.35	2.5	3.9	......	2.85	2.25	2.1	2.0	2.15
25	2.1	2.0	2.35	2.25	2.5	3.9	......	2.85	2.25	2.1	2.05	2.15
26	2.05	2.0	2.4	2.2	2.5	3.9	......	2.7	2.3	2.1	2.1	2.15
27	2.0	1.95	2.35	2.15	2.5	3.7	......	2.6	2.3	2.1	2.1	2.2
28	2.0	1.95	2.3	2.15	2.45	3.65	......	2.6	2.3	2.1	2.1	2.2
29	1.95	......	2.3	2.2	2.4	3.5	3.65	2.6	2.3	2.1	2.1	2.2
30	1.9	......	2.35	2.2	2.45	3.6	3.6	2.6	2.3	2.15	2.1	2.2
31	1.9	......	2.5	......	2.4	......	3.6	2.6	......	2.15	......	2.2

[a] Station discontinued; operations resumed July 29.

Rating table for Owens River near Round Valley, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	132	2.10	244	2.60	385	3.10	545	3.60	715
1.70	152	2.20	270	2.70	416	3.20	578	3.70	750
1.80	172	2.30	297	2.80	448	3.30	612	3.80	785
1.90	194	2.40	326	2.90	480	3.40	646	3.90	821
2.00	218	2.50	355	3.00	512	3.50	680		

NOTE.—This table is based on discharge measurements made during 1903–6 and is well defined between gage heights 1.7 feet and 2.8 feet.

Monthly discharge of Owens River near Round Valley, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	257	162	199	12,200
February	218	183	205	11,400
March	355	206	270	16,600
April	432	244	345	20,500
May	400	270	328	20,200
June	839	326	624	37,100
July[a]	732	663	696	42,800
August	680	385	535	32,900
September	385	284	330	19,600
October	312	244	273	16,800
November	257	218	239	14,200
December	270	218	256	15,700
The year	839	162	358	260,000

[a] Discharge interpolated July 5 to 28.

NOTE.—Values are rated as follows: June and July, good; remainder of 1906, excellent.

OWENS RIVER NEAR TINEMAHA, CAL.

This station was established September 20, 1906, but measurements were made prior to this date by the city of Los Angeles, Cal. It is located about 7 miles south of Tinemaha at a basaltic knoll in the floor of the valley known as "Charlies Butte." It was described in Water-Supply Paper No. 177 as near Independence.

The channel is straight for 300 feet above and 200 feet below the station. The right bank is high and rocky with a growth of willows along the bank; the left is low and liable to overflow at high stages of the river. The channel has a carrying capacity of about 1,800 second-feet before it overflows. The bed of the stream is composed of sand and gravel and is subject to some change between high and low stages of the river.

Discharge measurements are made from a cable and car. The initial point for soundings is a spike in post on right bank.

The gage, which is read by Ray Bowers, is a vertical rod fastened to a post on left bank of the stream. The bench mark is a nail in the south side of the post that supports the cable on the left bank; elevation, 8.36 feet above the zero of the gage.

During high water this station is inaccessible, and measurements are made at the county bridge near Citrus, about 12 miles below. The conditions at this station are described in Water-Supply Paper No. 177, p. 74, where are given, also, references to publications that contain data for previous years.

Discharge measurements of Owens River near Tinemaha, Cal., by G. R. Shuey, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 3	1.60	284	April 12	2.72	506
January 10	1.80	319	April 25		262
January 18	2.65	467	May 3	1.10	186
January 24		555	May 8	.90	162
February 6	2.11	377	May 24	1.16	201
February 14	2.04	347	June 5	1.30	224
February 21	1.93	350	June 18	3.93	786
February 26	1.80	314	October 8	1.40	293
March 8	1.70	277	October 18	1.57	360
March 20	2.92	523	November 1	1.80	418
March 27	2.67	478	December 8	2.62	532
April 6	2.37	462	December 17	2.60	515

Daily gage height, in feet, of Owens River near Tinemaha, Cal., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		1.45	1.80	2.15	17		1.55	2.05	2.60
2		1.52	1.85	2.20	18		1.57	2.05	2.55
3		1.45	1.90	2.30	19		1.58	2.05	2.50
4		1.40	1.90	2.45	20	1.85	1.60	2.00	2.45
5		1.40	1.95	2.60	21	1.82	1.55	2.00	2.40
6		1.38	2.00	2.70	22	1.80	1.57	2.00	2.35
7		1.40	2.00	2.65	23	1.75	1.60	2.00	2.35
8		1.40	2.05	2.60	24	1.72	1.70	2.00	2.40
9		1.38	2.05	2.55	25	1.60	1.82	2.10	2.45
10		1.36	2.05	2.50	26	1.50	1.85	2.05	2.50
11		1.35	2.00	2.45	27	1.45	1.87	2.10	2.55
12		1.35	2.00	2.50	28	1.40	1.85	2.20	2.60
13		1.30	2.00	2.70	29	1.35	1.90	2.30	2.65
14		1.35	2.00	2.80	30	1.38	1.80	2.20	2.70
15		1.38	2.05	2.70	31		1.80		2.75
16		1.45	2.10	2.70					

Rating table for Owens River near Tinemaha, Cal., from October 19, 1906, to December 31, 1906.

Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	278	1.50	342	1.90	402	2.30	470	2.70	542
1.10	290	1.60	357	2.00	418	2.40	488	2.80	560
1.20	302	1.70	372	2.10	434	2.50	506	2.90	580
1.30	314	1.80	387	2.20	452	2.60	524	3.00	600
1.40	327								

NOTE.—This table is based on 5 discharge measurements made during 1906 and is fairly well defined.

Discharge measurements of Owens River near Citrus, Cal., by Buttemer and Shuey in 1906.

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
January 3	283	July 13	2,210
January 19	440	July 21	2,460
January 21	595	July 29	2,610
June 4	214	August 9	1,160
June 16	586	August 17	1,160
June 26	1,370	September 10	432
July 1	1,520	October 7	321
July 8	2,080		

Monthly discharge of Owens River near Tinemaha, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	635	270	436	26,800
February	443	308	358	19,900
March	680	277	438	26,900
April	530	213	388	23,100
May	285	162	200	12,300
June	1,540	224	729	43,400
July	2,610	1,520	2,230	137,000
August	2,220	730	1,210	74,400
September	700	352	448	26,700
October	401	270	339	20,800
November	470	387	423	25,200
December	560	443	510	31,400
The year	2,610	162	642	468,000

NOTE.—From January 1 to June 30 the daily discharge was interpolated between measurements at the regular station. During July, August, and September the regular station was inaccessible on account of floods and the daily discharge has been interpolated between measurements made at Citrus. The values for these months are probably too small, as the Eastside and Stevens canals divert water above. After September the discharge was obtained from the rating table. Values for the year are approximate.

ROCK CREEK NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located at the wagon bridge on the road from Long Valley to Bishop, 3,500 feet above the mouth of the creek. The conditions and the bench marks are described in Water Supply Paper No. 177, page 52, where are given also references to publications that contain data for previous years.

Discharge measurements of Rock Creek near Round Valley, Cal., in 1906.

Date	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 8	F. R. S. Buttemer	13.5	17	1.58	23
January 14	do	14.6	21	1.93	41
August 27	R. S. Hawley	14	21	1.75	51
November 3	G. R. Shuey	13	16	1.55	37
November 30	do	13	19	1.70	47

Daily gage height, in feet, of Rock Creek near Round Valley, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	1.55	1.35	1.5	1.2	1.8	3.15	2.75	1.9	1.55	1.6	1.7
2	1.45	1.55	1.35	1.5	1.2	1.75	3.25	2.75	1.9	1.55	1.6	1.7
3	1.5	1.55	1.35	1.55	1.2	1.8	3.2	2.75	1.9	1.55	1.6	1.75
4	1.5	1.5	1.35	1.5	1.25	1.8	3.2	2.75	1.95	1.55	1.6	1.75
5	1.6	1.5	1.35	1.5	1.25	1.8	(a)	2.7	1.9	1.55	1.65	1.8
6	1.7	1.45	1.35	1.45	1.25	1.85	......	2.7	1.9	1.55	1.65	1.8
7	1.65	1.4	1.3	1.5	1.3	1.9	......	2.65	1.85	1.55	1.65	1.8
8	1.6	1.4	1.3	1.4	1.3	2.15	......	2.6	1.8	1.55	1.65	1.8
9	1.6	1.45	1.3	1.3	1.3	2.35	......	2.6	1.75	1.55	1.65	1.8
10	1.65	1.45	1.35	1.3	1.35	2.5	......	2.65	1.75	1.55	1.65	1.75
11	1.75	1.45	1.4	1.4	1.45	2.8	......	2.7	1.75	1.5	1.65	1.7
12	1.8	1.45	1.8	1.4	1.75	2.95	......	2.65	1.75	1.5	1.65	1.65
13	1.9	1.45	2.0	1.45	1.8	3.2	......	2.7	1.75	1.5	1.65	1.6
14	1.9	1.45	2.2	1.4	1.95	3.35	......	2.7	1.7	1.55	1.65	1.55
15	2.0	1.4	2.4	1.3	1.95	3.4	......	2.65	1.7	1.55	1.65	1.5

[a] Station discontinued; operations resumed July 29.

Daily gage height, in feet, of Rock Creek near Round Valley, Cal., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
16	2.1	1.4	2.3	1.3	1.9	3.4	......	2.6	1.7	1.55	1.65	1.5
17	2.1	1.4	2.2	1.3	1.9	3.4	......	2.55	1.7	1.55	1.65	1.55
18	2.1	1.4	2.2	1.25	2.2	3.45	......	2.55	1.7	1.55	1.65	1.6
19	4.2	1.4	2.1	1.25	2.3	3.5	......	2.6	1.65	1.55	1.65	1.6
20	1.4	1.4	2.1	1.2	2.4	3.5	......	2.65	1.65	1.6	1.65	1.6
21	1.5	1.4	1.95	1.2	2.4	3.55	......	2.6	1.6	1.6	1.6	1.6
22	1.6	1.4	1.8	1.2	2.3	3.6	......	2.5	1.55	1.6	1.5	1.6
23	1.7	1.4	1.7	1.2	2.3	3.7	......	2.45	1.5	1.55	1.45	1.6
24	1.7	1.4	1.6	1.2	2.25	3.7	......	2.45	1.5	1.5	1.45	1.6
25	1.6	1.35	1.55	1.15	2.1	3.8	......	2.45	1.5	1.5	1.5	1.6
26	1.55	1.35	1.6	1.15	2.15	3.8	......	2.0	1.55	1.45	1.6	1.6
27	1.5	1.35	1.5	1.15	2.0	3.6	......	2.0	1.55	1.45	1.7	1.6
28	1.5	1.35	1.4	1.15	1.85	3.55	......	1.95	1.6	1.45	1.75	1.6
29	1.55	......	1.4	1.2	1.8	3.4	2.85	1.9	1.6	1.45	1.8	1.6
30	1.55	......	1.4	1.2	1.8	3.5	2.85	1.9	1.55	1.5	1.8	1.6
31	1.55	......	1.5	......	1.8	......	2.8	1.9	......	1.55	......	1.6

Rating table for Rock Creek near Round Valley, Cal., from January 20, 1906, to December 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	12	1.60	40	2.20	83	2.80	131	3.40	179
1.10	15	1.70	47	2.30	91	2.90	139	3.50	188
1.20	19	1.80	54	2.40	99	3.00	147	3.60	197
1.30	23	1.90	61	2.50	107	3.10	155	3.70	206
1.40	28	2.00	68	2.60	115	3.20	163	3.80	215
1.50	34	2.10	75	2.70	123	3.30	171		

NOTE.—This table is based on 3 discharge measurements made during 1906 and is not well defined. The table used January 1 to 19 gives a much smaller discharge at the same gage height.

Monthly discharge of Rock Creek near Round Valley, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	200	17	38.8	2,390
February	37	25	29.7	1,650
March	99	23	45.7	2,810
April	37	17	24.6	1,460
May	99	19	54.2	3,330
June	215	50	145	8,630
July	167	131	[a] 150	9,220
August	127	61	107	6,580
September	64	34	47.4	2,820
October	40	31	35.9	2,210
November	54	31	42.6	2,530
December	54	34	43.5	2,680
The year	215	17	63.7	46,300

[a] Mean for seven days taken as mean for the month.

NOTE.—These values are fair.

PINE CREEK NEAR ROUND VALLEY, CAL.

This station was established August 3, 1903, by J. C. Clausen. It is located 150 feet below the wagon bridge on the road from Bishop to Long Valley and 100 feet above the mouth of the creek. The conditions and the bench marks are described in Water-Supply Paper

No. 177, page 55, where are given also references to publications that contain data for previous years.

On June 15, 1906, the gage was washed out. On August 23 a new gage was placed at the wagon bridge on the Long Valley road about 150 feet above the old gage. It consists of a ¼ by 1½ inch steel rod fastened to the downstream side of the bridge, near the right bank, and is graduated to 0.05 of a foot. No reference was made to any bench mark.

This section at the bridge is very rough and rocky, but not subject to much change. During very high stages gagings can be made from the bridge, while at ordinary stages a wading section below the bridge is more satisfactory.

Discharge measurements of Pine Creek near Round Valley, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 8	F. R. S. Buttemer	19	18	1.80	7.0
January 14	do	20	25	2.13	22
August 23	Shuey and Hawley	12	33	3.85	90
August 27	R. S. Hawley	24	26	3.75	92
November 3	G. R. Shuey	12	22	2.95	9.0
November 30	do	12	21	3.00	9.2

Daily gage height, in feet, of Pine Creek River near Round Valley, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	1.85	1.8	1.85	1.8	2.05	......	3.65	3.25	3.0	3.0
2	1.8	1.85	1.8	1.8	1.8	2.0	......	3.65	3.25	3.0	3.0
3	1.8	1.85	1.8	1.8	1.8	2.0	......	3.6	3.25	3.0	3.0
4	1.8	1.85	1.8	1.8	1.85	2.0	......	3.6	3.25	3.0	3.0
5	1.8	1.8	1.8	1.8	1.85	2.2	......	3.6	3.25	3.0	3.0
6	1.8	1.8	1.8	1.9	1.8	2.4	......	3.6	3.2	3.0	3.0
7	1.8	1.8	1.75	1.9	1.8	2.55	......	3.6	3.2	3.0	3.0
8	1.8	1.8	1.75	1.8	1.8	2.6	......	3.6	3.15	2.9	3.0
9	1.8	1.8	1.75	1.85	1.8	2.75	......	3.6	3.15	2.9	3.0
10	1.85	1.8	1.75	1.8	1.8	2.9	......	3.6	3.15	2.9	3.0
11	1.9	1.8	1.8	1.8	1.85	3.2	......	3.55	3.1	2.9	2.95
12	1.9	1.85	2.0	1.85	1.85	3.25	......	3.55	3.05	2.9	2.95
13	2.0	1.85	2.1	1.8	1.85	3.45	......	3.5	3.05	2.9	2.9
14	2.25	1.85	2.2	1.8	1.85	3.5	......	3.15	3.05	2.9	2.9
15	2.25	1.85	2.3	1.85	1.85	......	......	3.4	3.05	2.9	2.9
16	2.25	1.85	2.2	1.85	1.85	......	......	3.4	3.05	2.9	2.9
17	2.15	1.8	2.1	1.8	1.9	......	......	3.35	3.0	2.9	2.9
18	2.1	1.8	2.1	1.8	1.95	......	......	3.35	3.0	2.9	2.9
19	2.0	1.8	2.1	1.8	2.2	......	......	3.35	3.0	2.9	2.9
20	1.95	1.8	2.1	1.8	2.1	......	......	3.45	3.0	2.9	2.95
21	1.95	1.8	2.0	1.8	1.85	......	......	3.3	3.0	2.9	2.95
22	1.95	1.8	1.95	1.8	1.85	......	......	3.25	3.0	2.95	2.95
23	1.9	1.8	1.95	1.8	2.15	......	3.85	3.25	3.0	3.0	2.95
24	1.9	1.8	1.9	1.8	2.3	......	3.85	3.25	3.0	3.0	2.95
25	1.9	1.8	2.0	1.8	2.3	......	3.8	3.25	3.0	3.0	2.95
26	1.85	1.8	1.95	1.8	2.3	......	3.8	3.25	3.0	3.0	2.95
27	1.85	1.8	1.9	1.8	2.2	......	3.8	3.25	3.0	3.0	2.95
28	1.85	1.8	1.85	1.8	2.2	......	3.8	3.25	3.0	3.0	2.95
29	1.85	......	1.8	1.8	2.15	......	3.8	3.25	3.0	3.0	2.95
30	1.85	......	1.8	1.85	2.15	......	3.75	3.25	3.0	3.0	2.95
31	1.85	......	1.9	......	2.1	......	3.7	......	3.0	......	2.95

Rating tables for Pine Creek near Round Valley, Cal.

JANUARY 1 TO JUNE 14, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.70	4	2.10	23	2.50	45	2.90	75	3.30	119
1.80	8	2.20	28	2.60	52	3.00	85	3.40	133
1.90	13	2.30	33	2.70	59	3.10	95	3.50	149
2.00	18	2.40	39	2.80	67	3.20	106		

AUGUST 23 TO DECEMBER 31, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
2.90	5	3.20	24	3.40	42	3.60	64	3.80	89
3.00	10	3.30	33	3.50	53	3.70	76	3.90	103
3.10	16								

[a] This table is based on discharge measurements made during 1903-1906 and is well defined below gage height 3 feet.

[b] This table is based on 4 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Pine Creek near Round Valley, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	30	8	13.7	842
February	10	8	8.6	478
March	33	6	14.5	892
April	13	8	8.7	518
May	33	8	16.0	984
June			130	7,740
July			160	9,840
August			105	6,460
September	70	28	46.2	2,750
October	28	10	15.5	953
November	10	5	7.6	452
December	10	5	7.5	461
The year		5	44.4	32,400

NOTE.—Monthly means for June, July, and August estimated, and are only approximate; values for remainder of 1906 fair.

BISHOP CREEK NEAR BISHOP, CAL.

This station was established August 10, 1903, at the wagon bridge on the Bishop road, about 4½ miles from Bishop and about 2 miles from the point where the creek leaves the canyon. The conditions and the bench marks are described in Water-Supply Paper No. 177, page 62, where are given also references to publications that contain data for previous years.

Discharge measurements of Bishop Creek near Bishop, Cal., for 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 1[a]	F. R. S. Buttemer	16	28	1.95	20
January 16	do	16	24	1.76	32
January 24	do	16	27	1.83	38
August 24	Shuey and Hawley	16	41	3.10	241
November 5	G. R. Shuey	16	24	1.71	35
December 3	do	16	26	1.90	52

[a] Channel obstructed by rocks at time of measurement.

Daily gage height, in feet, of Bishop Creek near Bishop, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.95	1.6	1.6	1.8	2.5	2.45	4.75	4.0	2.8	2.2	1.5	1.85
2	1.85	1.65	1.65	1.7	2.4	2.4	4.9	3.9	2.75	2.2	1.45	1.85
3	1.85	1.6	1.6	1.8	2.45	2.45	5.2	3.8	2.7	2.15	1.35	1.9
4	1.6	1.65	1.65	1.8	2.5	2.5	5.5	3.7	2.7	2.2	1.4	1.95
5	1.6	1.6	1.6	1.8	2.55	2.55	5.3	3.75	2.65	2.2	1.4	1.95
6	1.6	1.65	1.65	1.9	2.6	2.5	5.6	3.75	2.6	2.1	1.45	1.9
7	1.5	1.6	1.65	1.95	2.65	2.6	(a)	3.8	2.65	2.15	1.45	1.85
8	1.5	1.6	1.7	1.9	2.75	2.75	....	3.7	2.65	2.2	1.4	1.9
9	1.5	1.6	1.7	1.9	2.9	2.9	....	3.65	2.6	2.1	1.45	1.85
10	1.55	1.55	1.7	1.9	2.95	3.7	....	3.75	2.65	2.0	1.4	1.9
11	1.65	1.6	1.7	1.75	2.85	3.9	....	3.8	2.6	2.0	1.5	2.0
12	1.6	1.55	1.8	1.75	2.75	3.75	....	3.7	2.6	1.95	1.65	1.95
13	1.5	1.6	1.5	1.7	2.9	3.65	....	3.65	2.5	1.9	1.65	2.0
14	1.5	1.6	2.0	1.6	2.85	3.6	....	3.65	2.5	1.9	1.7	2.0
15	1.75	1.6	2.0	1.7	2.8	3.7	5.45	3.7	2.4	1.8	1.7	1.95
16	1.8	1.6	2.2	1.8	2.8	3.85	5.4	3.7	2.45	1.75	1.65	2.0
17	1.9	1.6	2.2	1.8	2.85	3.8	5.5	3.75	2.4	1.75	1.65	1.95
18	2.0	1.6	2.2	1.85	2.9	3.9	5.4	3.7	2.4	1.7	1.65	2.0
19	2.1	1.6	2.1	1.85	2.95	3.9	5.3	3.7	2.35	1.7	1.7	1.9
20	2.1	1.6	2.1	1.9	3.0	4.2	5.1	3.65	2.4	1.75	1.65	1.95
21	2.3	1.65	2.0	1.95	2.95	4.5	5.0	3.6	2.3	1.75	1.65	1.9
22	2.15	1.7	2.0	2.0	2.8	4.7	5.0	3.7	2.25	1.75	1.6	1.95
23	2.0	1.6	2.0	2.0	2.85	4.75	5.3	3.65	2.2	1.75	1.6	1.9
24	1.9	1.65	1.9	1.9	2.75	4.8	5.0	3.65	2.3	1.8	1.65	1.9
25	1.85	1.85	1.9	2.0	2.8	4.9	5.4	3.6	2.2	1.75	1.65	1.9
26	1.8	1.6	1.95	1.95	2.75	4.95	5.1	3.55	2.2	1.7	1.7	1.95
27	1.7	1.65	1.9	2.55	2.7	4.5	5.1	3.4	2.2	1.7	1.85	2.0
28	1.75	1.65	1.9	2.55	2.65	4.35	5.3	3.35	2.25	1.65	1.8	2.0
29	1.65	....	1.85	2.55	2.6	4.2	4.4	2.8	2.2	1.6	1.8	1.95
30	1.6	....	1.9	2.5	2.5	4.4	4.4	2.85	2.2	1.55	1.8	1.95
31	1.65	.....	1.85	....	2.6	....	4.3	2.85	....	1.55	....	2.0

[a] Station discontinued; operation resumed July 15.

Rating table for Bishop Creek near Bishop, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	7	2.20	84	3.00	220	3.80	393	4.60	582
1.50	10	2.30	98	3.10	240	3.90	416	4.70	606
1.60	14	2.40	114	3.20	261	4.00	439	4.80	630
1.70	24	2.50	130	3.30	282	4.10	462	4.90	654
1.80	35	2.60	147	3.40	303	4.20	486	5.00	678
1.90	46	2.70	164	3.50	325	4.30	510	5.20	726
2.00	58	2.80	182	3.60	347	4.40	534	5.40	774
2.10	70	2.90	201	3.70	370	4.50	558	5.60	822

NOTE.—This table is based on 6 discharge measurements made during 1906, and is not well defined.

Monthly discharge of Bishop Creek near Bishop, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	98	10	33.4	2,050
February	40	12	16.4	911
March	84	10	42.0	2,580
April	138	14	52.8	3,140
May	220	114	172	10,600
June	666	114	382	22,700
July	822	510	[a] 706	43,400
August	439	182	350	21,500
September	182	84	124	7,380
October	84	12	45.3	2,780
November	40	6	17.5	1,040
December	58	35	50.0	3,070
The year	822	6	166	121,000

[a] Mean of 23 days taken as the mean for the month.

NOTE.—These values are fair.

BIG PINE CREEK NEAR BIG PINE, CAL.

This station was established December 5, 1903, by R. S. Hawley. It is located 3 miles southwest of Big Pine, Cal., at a point where the creek leaves the foothills. The conditions and the bench marks are described in Water-Supply Paper No. 177, page 78, where are given also references to publications that contain data for previous years. No gage-height record was kept during 1906.

Discharge measurements of Big Pine Creek near Big Pine, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft*	*Feet.*	*Sec.-ft.*
January 2	F. R. S. Buttemer	14	14	2.25	11
January 17	do	14	14	2.32	13
January 24	do	14	10	1.98	13
August 24	Hawley and Shuey	14	26	(a)	112
November 1	G. R. Shuey	8	12	(a)	24
December 6	do	9	13	(a)	20
December 16	do	8	13	(a)	20

a Gage out.

BIRCH CREEK NEAR TINEMAHA, CAL.

This station, originally established June 14, 1905, was reestablished on December 7, 1906. It is located about 8 miles south of Big Pine and 1 mile west of Fish Springs schoolhouse and about 500 feet west of Peterson's ranch house. The conditions at this station are described in Water-Supply Paper No. 177, page 80. The gage is a vertical staff nailed to a post, and is graduated to feet and tenths. The bench mark is two large spikes driven in the base of a 4-inch birch tree about 50 feet northeast of the rod; elevation, 0.52 feet above the zero of the gage.

Discharge measurements of Birch Creek near Tinemaha, Cal., in 1906.

Date	Hydrographer	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft*
January 11	G. R. Shuey			0.52	3.1
January 29	do				3.1
March 8	do				3.2
December 7	do	5	4.2	a .35	6.0

a By new gage.

Daily gage height, in feet, of Birch Creek near Tinemaha, Cal., for 1906.

Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.
7	0.45	14	0.4	21	0.3	28	0.4
8	.45	15	.35	22	.3	29	.35
9	.3	16	.3	23	.3	30	.35
10	.4	17	.3	24	.3	31	.35
11	.4	18	.3	25	.35		
12	.4	19	.3	26	.45		
13	.4	20	.3	27	.4		

TINEMAHA CREEK NEAR TINEMAHA, CAL.

Tinemaha Creek is tributary to Owens River from the eastern slope of the Sierra Nevada.

The station was established December 7, 1906. It is located about 500 feet south of the Peterson ranch house, about 8 miles south of Big Pine, and about 1 mile west of Fish Springs schoolhouse.

The channel is straight for about 40 feet above and for 30 feet below the measuring section, and the velocity is moderate at ordinary stages. Both banks are steep, about 5 or 6 feet high, and covered with a scrubby growth. The bottom is composed of clean gravel and is not likely to shift. There is one channel at all stages, and at low water the width is about 10 feet and the depth 0.5 feet. The section is good and gagings are made by wading.

The gage is a vertical staff, graduated to feet and tenths, and nailed to a post.

The following measurement was made December 7, 1906:

Width, 7 feet; area, 4 square feet; gage height, 0.50 foot; discharge, 5.9 second-feet.

Daily gage height, in feet, of Tinemaha Creek near Tinemaha, Cal., for 1906.

Day.	Dec.	Day.	Dec.	Day.	Dec.	Day.	Dec.
7	0.5	14	0.5	21	0.4	28	0.5
8	.5	15	.5	22	.5	29	.5
9	.5	16	.45	23	.5	30	.5
10	.5	17	.45	24	.5	31	.5
11	.5	18	.4	25	.5		
12	.5	19	.4	26	.55		
13	.5	20	.4	27	.5		

TABOOSE CREEK NEAR TIBBETTS, CAL.

Taboose Creek is tributary to Owens River from the eastern slope of Sierra Nevada.

The station was not established regularly until August 20, 1906, though discharge measurements were made throughout the year. It is located about 15 miles north of Independence, 2 miles northwest of Tibbetts railway station, and about one-half mile west of the crossing on the lower main highway.

The channel is straight for about 50 feet above and 50 feet below the station, and the velocity is moderate. Both banks are rather steep and 3 to 4 feet high and are not likely to overflow. The bed and banks are sandy, with little vegetation, and the channel is subject to slight change. At low stages the stream is about 10 feet wide and 0.5 feet deep.

Discharge measurements are made from a board used as a footbridge.

The gage is a vertical staff, about 3.5 feet long, graduated to feet and tenths, and nailed securely to a post driven in the bank. The bench mark is a spike driven in the base of a cottonwood tree 2 feet south of gage; elevation, 3.75 feet above the zero of the gage.

Discharge measurements of Taboose Creek near Tibbetts, Cal., by G. R. Shuey in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 18				3.6	May 23	7.8	7.4		11
February 21				2.7	June 1	7.8	5.9		8.9
March 20				3.6	June 11	7.0	7.8		22
March 27				3.5	July 2	8.0	10		29
April 6				3.4	July 7	10	14		46
April 12	7.0	3.2		4.2	July 14	10	15		56
April 19				8.0	July 27	8.5	12		45
April 24				8.4	August 2[a]	6.0	6.9	2.35	23
May 2	7.4	4.5		6.8	October 8[a]	3.7	1.9	1.80	3.4
May 8	8.0	7.1		12	December 8[a]	4.0	1.8	1.65	3.6
May 16	7.8	6.9		12					

[a] Measured at regular station.

Daily gage height, in feet, of Taboose Creek near Tibbetts, Cal., for 1906.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.1	1.85		1.75	17		2.25	1.81	1.75	
2		2.1	1.85			18		2.28			1.6
3		2.1	1.85	1.7	1.7	19	2.30	2.25		1.75	
4		2.2	1.85			20	2.32	2.15	1.80		1.6
5		2.2	1.85	1.7	1.7	21	2.35	2.1		1.75	
6		2.18	1.84			22	2.30	2.05			1.6
7		2.2		1.8	1.65	23	2.25	2.07	1.80		
8		2.18	1.80		1.65	24		1.95		1.75	1.6
9		2.2	1.82			25	2.15	1.9	1.80		
10		2.2		1.75		26	2.1	1.88			1.6
11		2.2			1.65	27	2.1	1.9	1.8	1.75	
12		2.2				28	2.1	1.9			
13		2.2	1.82	1.7	1.65	29	2.1	1.88	1.8	1.75	1.6
14		2.25				30	2.1	1.85			
15		2.25	1.82	1.7	1.65	31	2.1		1.78		
16		2.26									

Monthly discharge of Taboose Creek near Tibbetts, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	4.0	3.3	3.7	228
February	3.0	2.7	2.9	161
March	3.6	3.0	3.3	203
April	8.4	3.4	5.8	345
May	12	6.8	10.4	640
June	28	9.0	21.8	1,300
July	56	29	46.3	2,850
August	40	15	25.7	1,580
September	21	5.6	15.0	893
October	5.6	3.2	3.7	228
November	4.0	3.0	3.6	214
December	4.0	3.0	3.5	215
The year	56	3.0	12.1	8,860

NOTE.—Daily discharge prior to August 19 was obtained by interpolation between measurements. Values are approximate.

GOODALE CREEK NEAR TIBBETTS, CAL.

Goodale Creek is tributary to Owens River from the eastern slope of the Sierra Nevada.

The station was established September 20, 1906. It is located where the stream leaves the foothills, about 13 miles north of Independence, 4 miles west of Tibbetts railway station, and one-fourth mile west of the upper road crossing.

The channel is straight for 20 feet above and 15 feet below the measuring section, and the current is swift at all times. Both banks are low, clean, and sandy, but not likely to change materially. There is but one channel at all stages and discharge measurements are made from a plank used as a footbridge. At low water the stream is about 8 feet wide and nearly a foot deep.

The gage is a vertical staff nailed securely to a post driven in the bank. The reference bench mark is the top of a piece of steel driven in the ground about 5 feet south of gage and witnessed by a guard stake; elevation, 2.10 feet above the zero of the gage.

Discharge measurements of Goodale Creek near Tibbetts, Cal., by G. R. Shuey, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 12	4.0	1.8		2.6	June 19[a]				12
April 24				4.2	July 2[a]				17
May 2	4.0	1.8		2.5	July 7[a]				27
May 9	4.7	2.9		7.4	July 14[a]				27
May 16	4.7	2.9		7.4	July 27[a]	4.4	4.1		8.7
May 23	5.0	3.5		7.5	October 31[b]	5.6	3.4	0.60	5.4
June 1	4.7	2.8		4.9	December 8[b]	6.0	3.6	.60	4.6
June 11[a]				11					

[a] At upper road crossing.

[b] At regular station.

Daily gage height, in feet, of Goodale Creek near Tibbetts, Cal., for 1906.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	0.68		0.60	12				23	0.62		
2				13	0.60	0.60	0.55	24		0.60	0.50
3	.68	0.50	.60	14				25	.60		
4				15	.60	.60	.55	26			.50
5		.50	.60	16				27	.60	.60	
6	.65			17	.62	.65		28			
7		.60	.55	18			.50	29	.60	.60	.50
8			.60	19		.65		30			
9	.62			20	.60		.50	31	.60		
10		.55		21		.65					
11	.61		.55	22			.50				

Monthly discharge of Goodale Creek near Tibbetts, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January			[a] 2.0	123
February			[a] 1.0	56
March			[a] 1.0	61
April	4.2	2.6	3.5	208
May	7.5	2.5	6.3	387
June	16	4.9	11.2	666
July	27	6.8	19.0	1,170
August	6.6	6.2	6.4	394
September	6.3	4.8	5.9	351
October	6.3	5.4	5.6	344
November	5.6	5.0	5.3	315
December	4.6	4.0	4.3	264
The year	27	....	6.0	4,340

[a] Estimated.

NOTE.—The daily discharge from April to September was obtained by interpolation between measurements. Values are approximate.

DIVISION CREEK NEAR INDEPENDENCE, CAL.

Division Creek is tributary to Owens River from the eastern slope of Sierra Nevada, and measurements are made near where it leaves the foothills and enters the valley.

The station was established January 10, 1906, but no gage record was kept until September. It is located about 10 miles north of Independence on the upper road crossing, about 1½ miles west of the Ricky ranch house.

The channel is straight for about 10 feet above and 20 feet below the station. Both banks are low, and composed of gravel covered with weeds which extend a foot or two into the water; they are not subject to overflow. The bed is also of gravel, but is clean and not likely to change. The velocity is moderate and there is one channel at all stages. At low water the stream is 6 or 8 feet wide and about a foot deep. Discharge measurements are made from a plank used as a footbridge.

The gage is a vertical staff driven in the ground and nailed to a post. The bench mark is the top of a steel gad driven in the ground near a willow tree 20 feet west of gage; elevation, 4.45 feet above zero of gage.

Discharge measurements of Division Creek near Independence, Cal., by G. R. Shucy, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 18				8.1	May 16	6.5	3.3	2.26	7.5
February 15			2.23	5.1	May 23	6.5	3.3	2.26	7.5
February 21			2.23	5.1	June 1	6.2	3.1	2.25	6.0
March 3				5.0	June 11	6.1	3.3	2.28	7.7
March 15				9.0	June 19	6.1	3.7	2.30	9.2
March 20				5.4	June 25	6.3	4.3	2.35	9.9
March 27				4.7	July 2	6.3	4.2	2.40	11
April 6				4.9	July 7	6.6	5.0	2.45	13
April 12		3.0	2.25	5.4	July 14	7.0	6.7	2.65	17
April 18			2.30	6.5	July 27	6.5	7.1	2.95	22
April 24				7.4	August 18[a]	4.0	4.0	1.10	12
May 2	6.4	3.0	2.25	6.6	October 31	5.5	4.8	2.60	14
May 9	6.6	3.3	2.30	7.9	December 8	5.5	4.2	2.55	11

[a] Measured at ranch house.

Daily gage height, in feet, of Division Creek near Independence, Cal., for 1906.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.1				17					
2		1.1			2.5	18	1.1			2.55	
3		1.1				19	1.1				
4		1.1		2.6		20	1.1				
5		1.1				21	1.1		2.6		
6		1.1				22	1.1				
7		1.1	2.65			23	1.1	2.65			2.5
8		1.1				24	1.1				
9		1.1			2.55	25	1.1			2.4	
10		1.1				26	1.1				
11		1.1		2.6		27	1.1				
12		1.1				28	1.1		2.6		
13		1.1				29	1.1				
14		1.1	2.62			30	1.1	2.65			2.5
15		1.1				31	1.1		2.6		
16		1.1			2.5						

NOTE.—From August 18 to September 18 the gage record was kept at the ranch house.

Monthly discharge of Division Creek near Independence, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	8.1	5.3	6.7	412
February	5.3	5.0	5.1	283
March	9.0	4.7	6.1	375
April	7.4	4.8	6.0	357
May	7.9	6.1	7.3	449
June	10	6.0	8.4	500
July	22	10	17.2	1,060
August	20	12	14.3	879
September	12	10	10.9	649
October	14	10	12.6	775
November	14	8.0	11.5	684
December	11	10	10.1	621
The year	22	4.7	9.7	7,040

NOTE.—The daily discharge prior to August 18 was obtained by interpolation between measurements. Values are approximate.

EIGHTMILE CREEK NEAR INDEPENDENCE, CAL.

Eightmile Creek is tributary to Owens River from the eastern slope of Sierra Nevada; measurements are made near where the stream leaves the foothills and enters the valley.

The station was established September 20, 1906. It is located on the upper road crossing about 8 miles north of Independence and about 300 feet beyond the Eightmile ranch.

The channel is straight for about 15 feet above and 10 feet below the station. The bottom is of gravel, not likely to shift, but both banks are very low and liable to overflow. The velocity is high and there is only one channel at low water, but at high water there are two or three. At low water the stream has a width of about 6 feet and a depth of 0.5 foot. Measurements are made from a plank used as a footbridge.

The gage is a staff graduated into feet and tenths and nailed to a post. The bench mark is a spike driven in fence post 10 feet east of gage; elevation, 1.49 feet above the zero of the gage. During 1906 no gage-height record was kept.

Discharge measurements of Eightmile Creek near Independence, Cal., by G. R. Shuey, in 1906.

Date.	Width	Area of section	Discharge.
	Feet.	*Sq. Ft.*	*Sec.-ft.*
February 15			2.7
March 3			2.5
March 15			5.0
March 27			3.4
April 6			3.0
April 18			3.4
April 24	4.0	1.6	4.1
May 2	4.0	1.6	3.7
May 9	4.0	1.6	4.5
May 16	4.0	1.6	4.4
May 23			4.4
June 1	4.0	1.8	4.6
June 19	4.0	2.0	7.8
June 25	4.0	2.6	9.2
July 7			17
July 27	9.5	5.1	14
August 18	3.2	3.2	13
October 31[a]	6.0	2.8	5.0
December 8	8.0	3.5	5.0

[a] Gage height 0.40 foot at regular station.

Monthly discharge of Eightmile Creek near Independence, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January			[a] 3.0	184
February	2.8	2.5	2.7	150
March	5.0	2.5	3.7	228
April	4.1	3.0	3.4	202
May	4.6	3.7	4.3	264
June	13	4.6	7.6	452
July	20	13	16.3	1,000
August	14	11	12.6	775
September	11	8.3	9.8	583
October	8.2	5.0	6.7	412
November			[a] 5.0	298
December			[a] 5.0	307
The year			6.7	4,860

[a] Estimated.

NOTE. The daily discharge, February to October, was obtained by interpolation between measurements. Values are approximate.

OAK CREEK NEAR INDEPENDENCE, CAL.

This station was established June 15, 1905, about 1 mile west of old Fort Independence. The conditions and the bench marks are described in Water-Supply Paper No. 177, page 83.

A new station was established October 1, 1906. It is located at Bell's flour mill, about 3 miles northwest of Independence, and just above the division boxes which divide the stream into three parts.

The channel at the point of measurement is a flume 12 feet wide and 1 foot deep, with a gravel bottom which has to be cleaned out after high water. At very high stages the stream divides above the flume and forms two channels. Measurements are made by wading or from a plank used as a footbridge.

The gage is a staff nailed to a post on the north side of the stream.

Discharge measurements of Oak Creek near Independence, Cal., by G. R. Shuey, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 14			0.20	7.7	May 23	5	7.7	1.08	34
February 21			.20	7.1	June 3	5	7.7	1.08	36
March 3				7.5	June 16[a]				60
March 10				7.5	June 23	18	21		93
March 20				7.5	July 7	18	26		162
March 27				8.9	July 14	17	21		143
April 6				8.5	July 27	16	23		132
April 12	4	3.5	.30	10	August 9	16	22		77
April 21	4	4.3	.50	14	August 20	11	20		68
April 24	4	4.6	.50	17	September 23		6.0		21
May 2	4	4.1	.44	14	October 20	12	4.8	.35	17
May 9	4	6.5	.90	26	November 19	12	5.6	.30	12.4
May 14	5	6.9	.98	27	December 21	12	5.6	.25	10.6

[a] Measured in two channels.

Daily gage height, in feet, of Oak Creek near Independence, Cal., for 1906.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	0.40	0.30	0.20	12	0.40	0.30	0.30	23	0.37	0.25	0.25
2	.40	.30	.25	13	.40	.30	.30	24	.36	.25	.25
3	.40	.30	.30	14	.40	.30	.30	25	.36	.25	.25
4	.41	.30	.30	15	.40	.30	.30	26	.36	.25	.25
5	.42	.30	.30	16	.39	.30	.30	27	.35	.20	.25
6	.40	.30	.30	17	.39	.30	.25	28	.35	.20	.25
7	.40	.30	.30	18	.38	.30	.25	29	.30	.20	.25
8	.40	.30	.30	19	.38	.30	.25	30	.30	.20	.20
9	.40	.30	.30	20	.35	.30	.25	31	.30		.20
10	.40	.30	.30	21	.35	.30	.25				
11	.40	.30	.30	22	.35	.30	.20				

Monthly discharge of Oak Creek near Independence, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	....	....	[a]6.0	369
February	7.7	7.1	7.3	405
March	8.0	7.4	7.8	480
April	17	8.5	11.9	708
May	36	14	28.0	1,720
June	128	36	69.9	4,160
July	162	113	140	8,610
August	109	53	73.5	4,520
September	51	20	32.2	1,920
October	26	12	20.5	1,260
November	12	10	11.8	702
December	12	10	11.3	695
The year	162	....	35.0	25,500

[a] Estimated.

NOTE.—The daily discharge February to September was obtained by interpolation between measurements; after October 1 a rating table, based on three discharge measurements, was used; values are approximate.

INDEPENDENCE CREEK NEAR INDEPENDENCE, CAL.

The old station at the city waterworks, which was established June 15, 1905, was wrecked in June, 1906, and a new station was established on August 20, 1906. It is located about 1 mile west of the town of Independence and about 300 feet above the waterworks for the town.

The channel is straight for about 40 feet above and 30 feet below the station. Both banks are high and rocky and not liable to overflow. The bed is also rocky, but clean and fairly permanent. There is one channel at all stages and the velocity is high. At very high stages the section may change on account of the displacement of bowlders. Measurements are made from a plank used as a footbridge. At low water the stream is about 10 feet wide and 0.5 foot deep.

The gage is a staff nailed to a post on the south bank of the creek. The bench mark is a spike driven in a willow tree about 10 feet east of gage on south bank; elevation, 1.32 feet above zero of gage.

Discharge measurements of Independence Creek near Independence, Cal., in 1906.

Date.	Width.	Area of section	Gage height.	Discharge	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 23	.....	.....	0.42	4.5	June 4	8	8.6	0.85	31
January 30	.....	.....	.....	2.8	June 12	13	18	1.55	86
February 13	.....	.....	.36	2.4	June 23	11	17	....	130
March 2	.....	.....	.....	4.6	July 1	11	16	....	116
March 25	.....	.....	.....	4.9	July 9	11	20	....	144
April 5	.....	.....	.....	5.0	July 19	11	22	....	137
April 14	9	4.6	.50	6.6	August 9	....	....	....	60
April 22	10	5.9	.60	11	September 11	11	13	.90	26
April 30	9	6.1	.61	11	September 23	11	9.1	.67	16
May 10	10	7.5	.80	25	October 20	10	6.6	.50	7.5
May 22	10	11	.98	43	November 13	10	6.6	.45	5.0
May 29	9	9.4	.87	32					

NOTE.—Measurements January to August were made at old station; the gage was out after June 12. Measurements September to November were made at new station.

Daily gage height, in feet, of Independence Creek near Independence, Cal., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		0.6			12			0.4	0.4	23	0.67			
2			0.5	0.5	13	0.8	0.6	.45		24			0.4	0.4
3	0.9	.6			14			.5	.4	25	.7			
4			.5	.5	15	.8	.6			26			.5	.4
5	.9	.6			16			.4	.5	27	.6			
6			.4	.4	17	.8				28			.4	.5
7	.9				18		.6	.4	.4	29	.7			
8			.5	.4	19	.8				30				.4
9					20		.5	.5	.4	31				.4
10			.5	.4	21	.7	.7							
11	.9	.7			22		.6	.5	.5					

Monthly discharge of Independence Creek near Independence, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	4.5	2.8	4.0	246
February	4.2	2.4	2.8	156
March	5.0	4.4	4.8	295
April	11	5.0	8.0	476
May	43	12	29.6	1,820
June	226	31	96.4	5,740
July	144	88	127	7,810
August	84	37	54.4	3,340
September	36	15	22.9	1,360
October	16	7.5	12.4	762
November	10	4.0	6.1	363
December	7.5	4.0	5.2	320
The year	226	2.4	31.1	22,700

NOTE.—The daily discharge, January to August, was obtained by interpolation between measurements. Values are approximate.

SHEPHERDS CREEK NEAR INDEPENDENCE, CAL.

Shepherds Creek is tributary to Owens River from the eastern slope of Sierra Nevada. No regular station has been established on this stream, but a sufficient number of measurements have been made during 1906 to warrant a rough estimate of the yearly flow. All measurements have been made near the foothills.

Discharge measurements of Shepherds Creek near Independence, Cal., by G. R. Shucy, in 1906.

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
February 7	1.7	June 21	95
April 14	6.2	June 29	70
April 22	16	July 9	109
May 1	9.8	July 23	111
May 10	34	September 10	11
May 18	32	October 22	1.2
May 26	27	November 14	.3
June 2	15	December 19	3.4
June 12	60		

Monthly discharge of Shepherds Creek near Independence, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January			2.0	123
February			2.0	111
March			2.0	123
April	16	4.5	9.0	536
May	34	9.8	26.5	1,630
June	95	15	62.2	3,700
July	111	78	104	6,400
August	93	33	63.0	3,870
September	31	5.5	12.0	714
October	5.3	1.0	2.6	160
November			.5	30
December			3.0	184
The year			24.1	17,600

NOTE.—The daily discharge, April to October, was obtained by interpolation between measurements; mean for other months estimated. Values are approximate.

MOFFETT CREEK NEAR INDEPENDENCE, CAL.

Moffett Creek is tributary to Owens River from the eastern slope of the Sierra Nevada. No regular station has been established but during 1906 enough measurements were made to justify a rough estimate of the yearly flow. All measurements were made near the foothills.

Discharge measurements of Moffett Creek near Independence, Cal., by G. R. Shucy, in 1906.

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
April 14	1.5	June 21[a]	44
April 22[a]	6.5	June 29[a]	27
May 1[a]	3.9	July 9	39
May 10[a]	14	July 23[a]	28
May 18	14	September 10[a]	3.9
May 26	15	October 22[a]	1.6
June 2	10	December 19[b]	.2
June 12	37		

[a] Measured at diversion gates.

[b] Estimated.

Monthly discharge of Moffett Creek near Independence, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean	
January			1.0	61
February			1.0	56
March			1.0	61
April	6.5	1.5	3.2	190
May	15	3.9	12.5	769
June	44	10	31.3	1,860
July	39	19	30.3	1,860
August	19	8.2	13.4	824
September	7.8	2.9	4.3	256
October	2.9	1.3	2.0	123
November			1.0	60
December			.5	31
The year			8.5	6,150

NOTE.—The daily discharge April to October was obtained by interpolation between measurements; mean for other months estimated. Values are approximate.

GEORGES CREEK NEAR INDEPENDENCE, CAL.

Georges Creek is a tributary to Owens River from the eastern slope of the Sierra Nevada. No regular station has been established, but enough measurements were made during 1906 to warrant a rough estimate of the flow for the year. Measurements were made at or above the division gates.

Discharge measurements of Georges Creek near Independence, Cal., by G. R. Shuey, in 1906.

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
February 7	1.0	June 29	66
April 14	5.1	July 9	84
April 22	14	July 23	102
May 1	7.4	August 10	42
May 10	21	October 22	4.5
May 18	28	October 30	3.1
May 26	20	December 19	1.6
June 12	53		

Monthly discharge of Georges Creek near Independence, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean	
January			[a] 1.0	61
February			[a] 1.0	56
March			[a] 2.0	123
April	14		10.3	613
May	29	7.4	21.1	1,300
June	68	31	52.9	3,150
July	102	70	86.9	5,340
August	72	29	42.3	2,600
September	29	14	21.0	1,250
October	14	3.0	7.7	473
November	3.0	2.1	2.6	155
December	2.1	1.4	1.7	105
The year	102		20.9	15,200

[a] Estimated.

NOTE.—The daily discharge April to November was obtained by interpolation between measurements. Values are approximate.

LONE PINE CREEK NEAR LONE PINE, CAL.

Lone Pine Creek is tributary to Owens River from the eastern slope of the Sierra Nevada. The station was established September 25, 1906. It is located about three-fourths mile west of the town of Lone Pine and about 500 feet above the division boxes on the creek.

The channel is straight for 30 feet above and 20 feet below the station. Both banks are high and rocky and not subject to overflow. The bed is rocky and not likely to change, but the cross section is rough and uneven. There is one channel at all stages and the current is swift. At low water the stream is 7 feet wide and 0.8 foot deep. Measurements are made by wading or from a plank used as a footbridge.

The gage is a staff graduated to feet and tenths and is nailed securely to a post. The bench mark is a spike driven in the base of a birch tree on the south bank near the station; elevation, 4.85 feet above zero of gage.

Discharge measurements of Lone Pine Creek near Lone Pine, Cal., by G. R. Shuey, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 31		3.1	June 13		66
February 17		3.1	June 21		90
February 24		2.2	June 29		100
March 13		4.0	July 10		134
March 23		4.0	July 25		139
March 29		4.4	August 10		72
April 15		5.5	September 6		36
April 28		12	September 24[a]	1.92	18
May 10		26	October 23[a]	1.80	13
May 17		33	November 20[a]	1.70	8
May 26		32			

[a] Measured at regular station.

Daily gage height, in feet, of Lone Pine Creek near Lone Pine Cal., for 1906.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	1.89		1.7	12	1.81	1.7		23	1.8	1.7	1.7
2		1.7		13			1.7	24			
3	1.89		1.7	14				25		1.7	1.7
4		1.7		15		1.7	1.7	26			
5	1.89		1.7	16				27			1.7
6		1.7		17			1.7	28		1.7	
7			1.7	18				29			1.7
8	1.89	1.7		19		1.7	1.7	30		1.7	
9			1.7	20		1.7		31			1.7
10	1.83			21		1.7	1.7				
11			1.7	22							

Monthly discharge of Lone Pine Creek near Lone Pine, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January			[a] 3.0	184
February	3.1	2.2	2.9	161
March	4.5	2.7	3.8	234
April	14	4.5	7.2	428
May	40	15	28.5	1,750
June	103	42	73.5	4,370
July	139	106	129	7,930
August	111	44	68.4	4,210
September	43	17	27.2	1,620
October	16	12	14.0	861
November	8.0	8.0	8.0	476
December	8.0	8.0	8.0	492
The year	139	2.2	31.1	22,700

[a] Estimated.

NOTE.- The daily discharge January to September was obtained by interpolation between measurements. Values are approximate.

TUTTLE CREEK NEAR LONE PINE, CAL.

Tuttle Creek is tributary to Owens River from the eastern slope of the Sierra Nevada. During 1906 measurements were made regularly at a point near Lone Pine, where the stream leaves the foothills and enters the valley. These measurements are numerous enough to warrant a monthly estimate of the flow of the stream for the year. A gage-height record has been kept during November and December.

Discharge measurements of Tuttle Creek near Lone Pine, Cal., by G. R. Shuey, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 31		4.9	June 13	1.15	20
February 17	0.90	5.0	June 21	1.45	32
February 24	.90	4.4	June 29	1.60	39
March 13		4.2	July 25		67
March 23		4.2	August 11	1.65	35
March 29		4.6	September 6	1.40	18
April 15	.87	4.6	September 25	1.18	11
May 11	.98	10	October 24	1.12	9.5
May 18	1.02	12	November 20	1.13	8.5
May 26	1.05	13			

Daily gage height, in feet, of Tuttle Creek near Lone Pine, Cal., for 1906.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		1.1	9		1.1	17			25	1.15	
2	1.1		10	1.1		18		1.1	26		1.1
3		1.1	11		1.1	19	1.15		27		
4	1.1		12	1.15		20	1.13	1.1	28	1.1	1.1
5		1.1	13		1.1	21	1.15		29		
6	1.1		14			22		1.1	30	1.1	1.1
7		1.1	15		1.1	23	1.15		31		
8	1.1		16			24		1.1			

Monthly discharge of Tuttle Creek near Lone Pine, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January			[a] 5.0	307
February	5.0	4.4	4.8	267
March	4.6	4.2	4.3	264
April	7.6	4.6	5.4	321
May	15	7.8	11.1	682
June	40	16	26.0	1,550
July	67	41	54.1	3,330
August	51	22	33.1	2,040
September	21	10	14.2	845
October	11	9.5	9.6	590
November	10	8.0	9.0	536
December	8.0	8.0	8.0	492
The year	67		15.4	11,200

[a] Estimated.

NOTE.—The daily discharge February to December was obtained by interpolation between measurements. Values are approximate.

COTTONWOOD CREEK NEAR OLANCHA, CAL.

Cottonwood Creek discharges into Owens Lake from the Sierra Nevada; measurements are made near the foothills.

The station was established September 25, 1906. It is located about 15 miles south of Lone Pine and about one-fourth mile above the point of crossing of the Los Angeles conduit.

The channel is straight for about 40 feet above and 50 feet below the station. The right bank is high, rocky, and wooded; the left is comparatively low and not wooded; but neither bank is likely to overflow. The bed is rocky and permanent, and there is but one channel at all stages; but the current is very swift. At low water the stream is about 10 feet wide and 1 foot deep. Measurements are made from a plank used as a footbridge.

The gage is a staff nailed to a post.

Discharge measurements of Cottonwood Creek near Olancha, Cal., by G. R. Shuey, in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 6		5.6	June 28		300
March 29		12	July 10		249
April 20		28	July 24		190
April 27		31	August 12		104
May 19		158	September 26[a]	0.80	22
May 27		131	October 26[a]	.74	17
June 13		434	November 21[a]	.50	9.3

[a] Measured at regular station.

Daily gage height, in feet, of Cottonwood Creek near Olancha, Cal., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		0.8	0.7	0.5	12		0.7			23		0.5	0.6	
2		.8	.75		13		.7		0.6	24		.7		
3		.8	.75		14		.7			25		.75	.5	0.6
4		.8		.5	15		.7		.8	26	0.8	.74		
5		.75			16		.7	0.6		27	.8	.7	.5	.6
6		.7			17		.65			28	.8	.7		
7		.7		.5	18		.65	.6	.6	29	.8	.65	.5	.6
8		.7			19		.6			30	.8	.70		
9		.7		.6	20		.5		.6	31		.65		
10		.7			21		.5	.5						
11		.7		.6	22		.65		.6					

Monthly discharge of Cottonwood Creek near Olancha, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	7.4	5.5	6.2	381
February	9.4	7.4	8.2	455
March	13	9.5	10.9	670
April	35	14	24.2	1,440
May	158	40	114	7,010
June	434	172	333	19,800
July	287	166	225	13,800
August	161	70	104	6,400
September	68	22	42.4	2,520
October	22	10	15.9	978
November	17	9.0	13.3	791
December	22	9.0	12.8	787
The year	434	5.5	75.8	55,000

NOTE.—The daily discharge January to September was obtained by interpolation between measurements. During high water measurements were made below the point of diversion, so that the discharge is probably too low. Values are approximate.

ASH CREEK NEAR LONE PINE, CAL.

Ash Creek discharges into Owens Lake from the eastern slope of the Sierra Nevada. Numerous measurements have been made on this stream during 1906, but they have not been made at the same point, although all were above the point of diversion.

Discharge measurements of Ash Creek near Lone Pine, Cal., by G. R. Shuey in 1906.

Date.	Discharge.	Date.	Discharge.
	Sec.-ft.		*Sec.-ft.*
January 6	1.3	June 29	58
March 29	4.8	July 10	31
April 27	10.7	August 13	5.9
May 19	16	September 26	3.2
May 27	16	October 26	2.8
June 14	21	November 21	2.4

Monthly discharge of Ash Creek near Lone Pine, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	2.2	1.3	1.7	105
February	3.8	2.4	3.2	178
March	5.2	4.0	4.5	277
April	11	5.4	8.3	494
May	17	12	14.8	910
June	58	17	30.6	1,820
July	53	9.0	25.3	1,560
August	8.5	5.0	5.8	357
September	5.0	3.2	4.0	238
October	3.2	2.8	3.0	184
November	2.7	2.4	2.5	149
December	......	....	[a] 2.2	135
The year	5.8	1.3	8.8	6,410

[a] Estimated.

NOTE.—The daily discharge January to November was obtained by interpolation between measurements. Values are approximate.

MISCELLANEOUS MEASUREMENTS IN OWENS RIVER DRAINAGE BASIN.

The following is a list of the miscellaneous discharge measurements made in the Owens River drainage basin during 1906:

Black Rock Springs near Independence, Cal.—These springs are near the foothills, about 8 miles northwest of Independence, and the water from them discharges into Owens River. The following measurement was made December 12, 1906, at the point where the water emerges from the ground.

Width, 11 feet; area, 19 square feet; discharge, 27 second-feet.

Cottonwood Creek near Lone Pine, Cal.—This stream discharges into Owens Lake from the eastern slope of the Sierra Nevada. The following measurement was made September 26, 1906, at the mouth of the canyon where the stream enters the valley:

Width, 10 feet; area, 12 square feet; discharge, 25 second-feet.

Fish Springs near Tinemaha, Cal.—These springs are near the foothills, about 8 miles south of Big Pine, and the water from them discharges into Owens River. The following measurement was made December 7, 1906, in a flume near their source:

Width, 7 feet; area, 20 square feet; discharge, 36 second-feet.

Georges Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of Sierra Nevada. The following measurements were made in 1906, at the mouth of the canyon where the stream enters the valley:

September 7: Discharge, 25 second-feet.
October 30: Discharge, 4.8 second-feet.

Independence Creek near Independence, Cal.—This creek is tributary to Owens River from the Sierra Nevada. The following measurements were made in 1906:

September 11, at mouth of canyon: Area, 11 square feet; discharge, 28 second-feet.
November 13, at Pinon ditch: Width, 5.4 feet; area, 3.3 square feet; discharge, 5.3 second-feet.

Lone Pine Creek near Lone Pine, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made in 1906, at the mouth of the canyon where the stream enters the valley:

September 8: Width, 10 feet; area, 12 square feet; discharge, 31 second-feet.
September 24: Area, 9.3 square feet; discharge, 20 second-feet.
October 23: Width, 8.3 feet; area, 6.7 square feet; discharge, 10 second-feet.

North Fork Oak Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made in 1906:

August 20, in canyon: Area, 7.8 square feet; discharge, 49 second-feet.
November 17, 3 miles above junction with South Fork: Width, 4.3 feet; area, 4.2 square feet; discharge, 12 second-feet.
November 19, at junction with South Fork: Width, 8 feet; area, 4.6 square feet; discharge, 12 second-feet.

South Fork Oak Creek near Independence, Cal.—This stream is south of North Fork and is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made in 1906:

August 20, in Canyon: Area, 9.9 square feet; discharge, 52 second-feet.
November 19, at junction with North Fork: Width, 6.5 feet; area, 3.3 square feet; discharge, 4.3 second-feet.

Shepherds Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. The following measurements were made November 14, 1906:

At mouth of canyon: Width, 6.5 feet; area, 3.9 square feet; dishcarge, 5.4 second-feet.
At fork 4 miles east of canyon: Width, 6 feet; area, 4 square feet; discharge, 3.5 second-feet.

Taboose Creek near Tibbetts, Cal.—This creek is tributary to Owens River from the eastern slope of the Sierra Nevada. On December 8, 1906, a measurement was made on the upper road crossing 2 miles above gaging station.

Width, 8 feet; area, 3.6 square feet; discharge, 5.4 second-feet.

Thebaut Creek near Independence, Cal.—This stream is tributary to Owens River from the eastern slope of the Sierra Nevada. On November 17, 1906, the following measurement was made at the mouth of the canyon where it enters the valley:

Width, 1.4 feet; area, 0.5 square foot; discharge, 1.6 second-feet.

MOHAVE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Mohave River rises on the northern slope of the San Bernardino Mountains, and, flowing in a northerly direction, finally disappears in the sands of the Mohave Desert. This stream has few tributaries, the only ones of importance being West Fork and Deep Creek, which have their source in the higher elevations of the San Bernardino Mountains. The formation is of granite, with a good covering of soil. On the higher elevations there is a considerable growth of timber, which diminishes as one approaches the lower reaches, changing to a light growth of brush and grass, finally merging into the barren desert. During the greater portion of the year the stream bed is dry below the junction of West Fork and Deep Creek, where the waters disappear in the sand and gravelly bed of the stream. Water again rises at a point lower down on the river above Victorville, where the gaging station is located. Water is diverted above and below the gaging station, but is again returned to the river channel. There are several artesian wells along the river above the gaging station, the water being used for irrigation. This stream does not discharge in any large quantity except during an extremely heavy rainfall in the winter months. The precipitation throughout this basin is very light, with the possible exception of the higher elevation of the San Bernardino Mountains, where there is a considerable fall of snow during the winter months, which melts in the early spring.

MOHAVE RIVER AT VICTORVILLE, CAL.

This station was established February 27, 1899, and discontinued July 31, 1906. It is located in the town of Victorville, a station on the Atchison, Topeka and Santa Fe Railroad, where the Mohave River passes through a narrow gorge locally known as the "Narrows." The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 87, where are given also references to publications that contain data for previous years.

The gage heights observed at this station in 1906 are of no value, therefore no discharges have been computed.

Discharge measurements of Mohave River at Victorville, Cal., by P. H. Leahy in 1906.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*		*Feet.*	*Sec.-ft.*
January 2	4.03	65	March 28[a]	4.40	1,240
January 6		63	March 30	4.30	1,430
January 9	4.03	67	March 31	4.30	965
January 12	4.09	66	April 2	4.60	682
January 16		66	April 6	4.50	647
January 20	4.17	88	April 10	4.50	525
January 23	4.11	62	April 13	4.30	401
January 26	4.10	72	April 17	4.20	348
January 31	4.10	65	April 20	4.20	273
February 2	4.10	64	April 24	4.10	202
February 6	4.10	67	April 28	4.20	222
February 10	4.10	68	May 1	4.20	227
February 13	4.11	64	May 3	4.20	202
February 17	4.11	50	May 11	4.00	123
February 21	4.12	79	May 19	4.00	42
February 24	4.12	65	May 25	4.02	44
February 27	4.08	70	June 1	4.40	187
March 2	4.11	67	June 10	4.00	74
March 7	4.11	52	June 17	3.92	32
March 9	4.10	56	June 24	4.05	38
March 12	7.80	9,200	June 29	4.16	29
March 18	4.15	1,620	July 5	4.24	27
March 20	4.11	828	July 13	4.31	28
March 23	4.45	552	July 19	4.32	33
March 25	6.25	4,530	July 22	4.36	33
March 26	5.60	5,570	July 29	4.41	31
March 27[a]	4.90	2,100	July 31[b]	4.39	22
March 27[a]	4.80	1,880	November 12[c]		41

[a] Measured by Burrage and Leahy. [b] Measured by W. B. Clapp. [c] Measured by W. F. Martin.

SOUTHERN PACIFIC OCEAN DRAINAGE.

GENERAL FEATURES.

The Southern Pacific Ocean drainage includes those streams south of San Francisco Bay whose waters, in times of flood at least, reach the Pacific Ocean.

SAN DIEGO BAY DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The principal streams tributary to San Diego Bay are Tia Juana, Sweetwater, and San Diego rivers.

The Tia Juana is not measured at any regular station, but stations are maintained on Cottonwood Creek, which discharges into it about 30 miles east of San Diego city, and on Pine Creek, a branch of Cottonwood, and stations are also maintained on Sweetwater and San Diego rivers.

Measurements in this basin are made for use in connection with the construction of reservoirs for irrigation purposes.

COTTONWOOD CREEK NEAR JAMUL, CAL.

Cottonwood Creek rises on the west side of the San Jacinto Mountains, in the southwestern part of San Diego County, at an elevation of about 5,000 feet, and flows in a southwesterly direction, discharging into the Tia Juana River just above the California-Mexico boundary line and about 30 miles east of San Diego city. Its drainage basin is rough and broken, with numerous hills and gorges and only a few small valleys. A scrubby timber growth throughout the basin consists mainly of oak, with some sycamore and cottonwood. The annual precipitation varies from 10 to 30 inches and is mainly in the form of rain. The light snowfall on the higher parts of the area melts rapidly, increasing the torrential nature of the run-off. There are several dam sites in this basin, at least two of which have been utilized. The rock formation through which the creek flows is a loose granite with a good soil covering.

The station was established December 14, 1905. It is located at the Barrett dam site, about 8 miles north of the California-Mexico boundary line, and is reached by driving from San Diego to Jamul ranch house, about 20 miles east of San Diego, then driving to the dam site, about 15 miles farther east, making the total distance from San Diego about 35 miles.

The measuring section was first located on the broad crest of the concrete foundation wall of the original Barrett dam, but some time in the late summer the gage was removed on account of constructive operations in connection with the new dam. Above this section the channel had filled in so that the sand was level with the crest of the wall, while on the lower side the water had a free fall of 30 feet. Vertical timber walls had been built up at each end of the dam, so that the width of the channel at all stages was 70 feet. The grade above the section was heavy, so that very high velocities prevailed in flood stages. A new section has been selected a few hundred feet above the old one, at the foundation of the new dam. At low stages the flow is restricted to a rectangular wooden flume through the foundation wall, but at higher stages the flow is over the entire length of the foundation wall.

Discharge measurements are usually made by wading, except in high stages, when only float measurements can be made, owing to the torrential nature of the stream. In low stages a section suitable for wading is always used. There is no cable and car equipment at this station.

The old gage was a 2 by 4 inch pine scantling, graduated to feet and tenths with black stripes and staples and attached in a vertical position to the timber wall on the left bank. The new gage is in two sections, a low-water gage attached to the foundation wall near the wooden flume and a high-water gage fastened to bowlders on the left bank. During 1906 the gage was read twice a day by Joe Hooker. No permanent bench mark for reference has yet been established.

Discharge measurements of Cottonwood Creek near Jamul, Cal., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 18	W. B. Clapp	2.7	0.5	....	0.5
December 14	C. H. Lee	5	1.6	0.05	1.1
1906.					
January 5	W. V. Hardy	6	2.9	0.10	3.5
January 19	do	16	6.7	0.21	12.4
January 19	do	22	12.5	0.30	32
January 20	do	70	20	0.40	39
January 20	do	70	28	0.50	63
January 20	do	70	29	0.55	76
February 3	do	10	3	0.05	4.1
February 14	do	20	8.7	0.23	15.5
March 11	do	21	7.7	0.12	13.2
March 12	do	70	71	1.21	383
March 13[a]	Joe Hooker	70	154	2.20	644
March 16[a]	do	70	57	0.82	150
March 21[a]	do	70	41	0.58	90
March 24[a]	do	70	420	6.00	5,330
March 25[a]	do	70	455	6.50	4,100
March 31[a]	do	70	77	1.10	416
April 7[a]	do	70	57	0.81	239
April 19	W. V. Hardy	70	37	0.59	116
May 8	do	70	27	0.40	76
June 22	C. H. Lee	36	9.9	0.28	14.2
October 5	W. F. Martin	2.8	0.8	....	1.0
November 27	W. V. Hardy	6	5.4	[b]0.90	32
December 15	do	6	6	[b]2.00	40

[a] Measured by floats. [b] New gage.

Monthly discharge of Cottonwood Creek near Jamul, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	59	2.0	15.5	953
February	100	7.0	24.1	1,340
March	5.800	5.0	594	36,500
April	350	93	176	10,500
May	93	20	54.9	3,380
June	55	20	30.5	1,820
July	93	2.0	12.0	738
August	51	.9	6.0	369
September	4.8	.8	1.3	77
October	7.1	.9	3.0	184
November	33	7.6	20.4	1,210
December	375	30	80.8	4,970
The year	5,800	.8	84.9	62,000

NOTE.—Discharges were obtained by the indirect method for shifting channels. Values are fair.

PINE VALLEY CREEK NEAR JAMUL, CAL.

Pine Valley Creek flows in a southerly direction and enters Cottonwood Creek about 1 mile north of Barrett's dam. Its drainage area is about half of the total drainage area of Cottonwood Creek above Barrett's dam. The gaging station is located a few hundred feet above the confluence of the two creeks and was established in January, 1906. It is reached in connection with the Cottonwood station by driving from San Diego.

The channel at the station is composed of shifting sand, and is straight for about 200 feet above and 250 feet below the point of measurement. The right bank is high and rocky and not subject to overflow, while the left bank is liable to overflow in very high stages, forming two channels. In almost all stages measurements can be made by wading, but two wires have been stretched across the channel 50 feet apart for convenience in float measurements. There is no cable and car.

The gage, which during 1906 was read twice a day by Joe Hooker, is a piece of 2 by 6 inch pine painted white and graduated to feet and tenths with staples. It is fastened to a small tree in a vertical position and the graduations run from 3 to 9.9 feet. The initial point for soundings is the top of a bowlder on the right bank marked with a ring of white paint. The top of this bowlder is also taken as a bench mark, with assumed elevation 1,600 feet. The zero of gage is 13.16 feet below, or at elevation 1,586.84.

Discharge measurements of Pine Valley Creek near Jamul, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 5	W. V. Hardy	6	1.5	....	1.8
January 19	do	14	7.2	3.10	14.4
January 19	do	34	12.3	3.20	17.6
January 20	do	41	19.4	3.45	41
February 3	do	8	2.8	2.94	4
February 15	do	42	13.1	3.12	20
March 11	do	12	5.4	3.00	8.2
April 19	do	46	23	4.50	57
May 8	do	47	16	4.40	32
June 22	C. H. Lee	17	4.8	4.20	7.7
October 5	W. F. Martin	2.8	0.21	4.00	0.24
November 27	W. V. Hardy	11	4.1	4.21	6.7
December 15	do	19	6.7	4.30	14.6

Daily gage height, in feet, of Pine Valley Creek near Jamul, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	......	3.00	3.00	4.90	4.55	4.40	4.12	4.02	3.95	3.94	4.10	4.15
2	......	2.95	3.00	4.90	4.55	4.35	4.12	4.01	3.95	4.03	4.05	4.20
3	......	2.95	2.98	4.75	4.50	4.35	4.11	4.01	3.95	4.10	4.05	4.20
4	......	2.95	3.00	4.75	4.50	4.30	4.12	4.00	3.95	3.98	4.00	4.20
5	......	2.96	3.04	4.80	4.55	4.30	4.13	3.95	3.94	3.80	4.10	4.20
6	......	3.24	2.98	4.75	4.50	4.30	4.10	3.93	3.94	3.55	4.10	4.25
7	......	3.15	2.92	4.80	4.50	4.30	4.20	3.80	4.00	3.60	4.10	4.25
8	......	3.07	2.93	4.70	4.40	4.30	4.20	3.79	4.00	3.70	4.10	4.25
9	......	3.09	2.92	4.65	4.40	4.30	4.22	3.76	3.98	3.75	4.10	4.25
10	......	3.01	2.95	4.65	4.40	4.30	4.20	3.65	3.98	3.80	4.10	4.20
11	......	3.11	2.97	4.60	4.35	4.25	4.17	3.60	4.00	4.00	4.05	4.25
12	......	3.01	4.35	4.55	4.40	4.20	4.15	3.55	4.00	4.00	4.10	4.30
13	......	3.01	5.00	4.60	4.40	4.20	4.12	3.48	4.09	4.05	4.10	4.45
14	......	3.09	4.03	4.55	4.40	4.20	4.12	3.40	4.08	4.05	4.05	4.45
15	......	4.02	3.70	4.55	4.40	4.20	4.10	3.37	4.12	3.95	4.10	4.30
16	......	3.60	4.04	4.50	4.40	4.20	4.11	3.00	4.02	3.95	4.10	4.30
17	......	3.40	3.95	4.50	4.35	4.20	4.10	2.70	4.05	4.00	4.10	4.20
18	3.00	3.30	3.60	4.50	4.35	4.20	4.10	4.40	3.96	4.00	4.10	4.20
19	3.20	3.28	3.50	4.50	4.30	4.15	4.11	4.40	4.05	4.10	4.05	4.30
20	3.45	3.20	3.38	4.50	4.30	4.15	4.10	4.20	4.03	4.05	4.05	4.20
21	3.25	3.21	3.31	4.45	4.30	4.10	4.07	4.20	3.98	4.10	4.10	4.20
22	3.20	3.22	3.35	4.45	4.40	4.20	4.05	4.20	4.02	4.10	4.10	4.15
23	3.18	3.19	3.30	4.50	4.40	4.15	4.06	4.20	3.91	4.05	4.20	4.20
24	3.10	3.08	......	4.50	4.40	4.15	4.06	4.19	4.01	4.10	4.20	4.20
25	3.08	3.01	......	4.50	4.40	4.15	4.05	4.18	4.03	4.05	4.20	4.20
26	3.05	2.96	......	4.50	4.50	4.15	4.05	4.18	4.00	4.00	4.20	4.20
27	3.03	2.94	......	4.50	4.45	4.15	4.05	4.18	4.04	4.10	4.20	4.30
28	3.03	2.97	5.20	4.65	4.50	4.20	4.04	4.16	3.98	4.10	4.20	4.70
29	3.03	......	4.82	4.75	4.50	4.15	4.03	4.10	3.92	4.10	4.10	4.60
30	3.03	......	4.80	4.65	4.40	4.15	4.02	4.00	4.00	4.00	4.15	4.50
31	3.03	......	5.00	......	4.40	....	4.02	4.00	......	4.10	......	4.50

Monthly discharge of Pine Valley Creek near Jamul, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	41	1	10.4	640
February	75	5	19.4	1,080
March	1,500	3	156	9,590
April	150	44	89.6	5,330
May	71	15	39.4	2,420
June	32	1.8	9.8	583
July	8.2	.6	2.6	160
August	32	0.0	4.0	246
September	2.7	.2	.6	36
October	1.8	0.0	.8	49
November	6.5	.3	2.6	155
December	114	4.2	20.1	1,240
The year	1,500	0.0	29.6	21,500

NOTE.—Discharges were obtained by the indirect method for shifting channels. Values are approximate.

SWEETWATER RIVER NEAR DESCANSO, CAL.

Sweetwater River heads on the west slope of San Jacinto Mountains in the west-central portion of San Diego County and flows in a southwesterly direction, discharging into San Diego Bay near National City. The highest parts of the basin are found about 2 miles east of Cuyamaca, at an elevation of more than 5,000 feet. This basin consists of a loose granite formation, and the topography is very much broken with numerous canyons, mountain peaks, and small valleys. There is a scrubby timber growth on the highlands, consisting mainly of oak brush. The annual precipitation in the basin varies from 5 to 20 inches near National City, but increases on the higher elevations up to from 30 to 60 inches near Cuyamaca, where 20 to 30 inches of snowfall occur in some years. The run-off in surface flow is heavy in the spring, but during the summer and fall the surface flow entirely disappears in the sands of the lower reaches.

This station was established December 9, 1905. It is located on the Ellis ranch, about 1 mile south of Descanso post-office, and is reached by stage from Lakeside. This station is at an elevation of 3,300 feet and has a drainage area of only 40 square miles, which is almost rectangular in outline, being about 10 miles long north and south and 4 miles wide.

The station is equipped with cable and car, but measurements can always be made by wading, except at very high stages. The bed of the stream is composed of sand and gravel, with isolated bowlders, and is subject to more or less change. Both banks may be overflowed at exceptionally high stages. The channel is straight for 150 feet above and 300 feet below the station. A dense growth of willows on each bank has been cleared away for 20 feet above and below the cable. The grade is heavy above the section, so that high velocities are encountered at the highest stage, when only float velocities can be taken.

The gage consists of a 2 by 6 inch pine timber painted white and graduated to feet and tenths. It is bolted to granite bowlders on the left bank, and is in three sections—two for low water and one for high water. The graduations extend from 2.8 to 10.7 feet.

The initial point for soundings is the head of a big nail driven in the base of the oak tree anchorage on the right bank. The bench mark is the highest point on the bowlder to which the lowest low-water gage is fastened, and is 20 feet upstream from station 60 of cable. It is marked 0.0 in white paint and its elevation is assumed to be 3,300 feet. The zero of the gage is 5 feet below the bench mark, or at an elevation of 3,295.0.

During 1906 the gage was read twice a day by C. H. Ellis.

Discharge measurements of Sweetwater River near Descanso, Cal., in 1905-6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1905.					
September 11[a]	D. W. Murphy				0.4
November 21	C. H. Lee	3	0.9	3.54	1.1
December 10	do	6	1.9	3.62	2.5
1906.					
January 6	W. V. Hardy	6.5	1.7	3.62	2.7
January 23	do	11	4.9	3.79	9.3
February 4	do	10	3.7	3.68	4.8
February 15	do	40	41	4.60	115
February 16	do	38	35	4.50	96
February 16	do	36	30	4.40	75
February 16	do	36	27	4.30	62
February 16	do	34	22	4.20	51
February 16	do	32	20	4.10	46
February 17	do	31	15.9	4.00	32
February 19	do	30	12.4	3.90	20
March 10	do	11.7	5.1	3.88	10.7
April 5	do	40	32	4.85	81
April 6	do	41	33	4.65	74
April 18	do	36	14	4.27	37
April 20	do	35	13	4.20	35
May 8	do	31	10.4	4.05	24
June 19	C. H. Lee	12	2.6	3.60	4.3
August 7	R. S. Hawley	2.5	0.8	3.16	1.1
October 9	W. F. Martin	2	1.2	3.15	1.1
November 28	W. V. Hardy	6	3.2	3.20	4.4
December 13	do	12	6.8	3.48	12.7

[a] Weir measurement.

Daily gage height, in feet, of Sweetwater River near Descanso, Cal., for 1905-6.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1905.			8		3.58	16		3.60	24	3.54	[a]3.62
1		3.60	9		3.58	17		3.60	25	3.53	3.64
2		3.64	10		3.64	18		3.67	26	3.54	3.65
3		3.61	11		3.68	19		3.66	27	3.81	3.65
4		3.60	12		3.69	20		3.66	28	3.84	3.65
5		3.60	13		3.65	21	3.53	3.78	29	3.71	3.69
6		3.58	14		3.60	22	3.54	3.70	30	3.70	3.66
7		3.58	15		3.60	23	3.54	3.62	31		3.72

[a] Estimated.

Daily gage height, in feet, of Sweetwater River near Descanso, Cal., for 1905-6—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
1	3.7	3.65	4.0	4.8	4.2	3.9	3.45	3.2	3.3	3.15	[a]3.2	3.2
2	3.65	3.65	3.95	4.7	4.15	3.85	3.4	3.2	3.3	3.15	[a]3.2	3.25
3	3.7	3.65	3.9	4.7	4.1	3.85	3.4	3.2	3.3	3.15	[a]3.2	3.25
4	3.7	3.7	4.0	4.6	4.1	3.85	3.4	3.2	3.3	3.15	[a]3.2	3.3
5	3.65	3.85	3.95	4.7	4.2	3.85	3.4	3.2	3.3	3.1	3.2	3.25
6	3.65	3.95	3.9	4.7	4.15	3.85	3.4	3.2	3.3	3.1	3.2	3.25
7	3.6	3.9	3.85	4.65	4.15	3.8	3.4	3.2	3.3	3.1	3.2	3.2
8	3.6	3.8	3.85	4.6	4.1	3.8	3.4	3.2	3.3	3.1	3.2	3.2
9	3.6	3.8	3.85	4.6	4.25	3.75	3.4	3.2	3.3	3.1	3.2	3.2
10	3.6	3.85	3.85	4.5	4.0	3.7	3.4	3.15	3.25	3.1	3.15	[a]3.2
11	3.6	3.95	3.9	4.45	4.0	3.7	3.35	3.15	3.25	3.1	3.15	[a]3.4
12	3.6	3.9	4.95	4.4	4.1	3.7	3.35	[a]3.15	3.25	3.1	3.15	3.9
13	3.65	3.9	5.05	4.4	4.0	3.7	3.35	3.15	3.25	3.1	3.15	3.45
14	3.75	3.9	4.5	4.35	4.0	[a]3.65	3.4	3.15	3.3	3.1	3.2	3.3
15	3.7	4.45	4.4	4.35	3.95	[a]3.65	3.4	3.15	3.65	3.1	[a]3.2	3.2
16	3.7	4.2	4.65	4.3	3.9	[a]3.6	3.35	3.15	3.45	3.1	[a]3.15	3.2
17	3.65	4.1	5.05	4.3	3.9	3.6	3.35	3.3	3.25	3.15	[a]3.15	3.2
18	3.65	3.95	4.65	4.25	3.9	3.6	3.3	3.6	3.2	3.15	3.15	3.2
19	4.05	3.9	4.5	4.25	3.9	3.6	3.3	3.6	3.15	3.15	3.15	3.2
20	4.15	3.85	4.4	4.2	3.9	3.6	3.3	3.5	3.15	3.15	3.15	3.2
21	3.9	3.95	4.35	4.2	3.9	3.55	3.3	3.45	3.15	3.15	3.15	3.2
22	3.85	4.0	4.45	4.15	3.85	3.55	3.3	3.4	3.1	3.15	3.4	3.2
23	3.8	3.95	4.35	4.1	3.9	3.55	3.3	3.4	3.1	3.2	3.45	3.2
24	3.75	3.9	7.35	4.15	3.9	3.55	3.3	3.45	3.15	3.2	3.35	3.2
25	3.75	3.85	6.8	4.15	3.9	3.5	3.35	3.35	3.15	3.2	3.3	3.2
26	3.75	3.85	6.6	4.1	4.05	3.55	3.35	3.35	3.15	3.2	3.3	3.45
27	3.7	3.85	5.6	4.1	4.0	3.6	3.3	3.35	3.1	3.2	3.35	3.7
28	3.7	3.95	5.2	4.4	4.2	3.55	3.25	3.35	3.1	3.25	3.2	4.5
29	3.7	......	4.85	4.4	4.0	3.5	3.25	3.35	3.15	3.25	3.2	3.8
30	3.7	......	4.7	4.25	3.95	3.45	3.2	3.35	3.2	3.2	3.2	3.5
31	3.7	......	4.7	......	3.9	......	3.2	3.3	......	[a]3.2	......	3.5

[a] Estimated.

Monthly discharge of Sweetwater River near Descanso, Cal., for 1906.

[Drainage area, 40 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	44	2.0	8.7	534	0.217	0.25
February	86	4.2	22.3	1,240	.558	.58
March	1,250	17.0	180	11,100	4.50	5.19
April	84	26	48.5	2,890	1.21	1.35
May	36	13	21.6	1,330	.540	.62
June	15	2.6	7.0	418	.176	.20
July	2.6	1.2	1.8	112	.046	.05
August	4.6	1.1	1.8	108	.044	.05
September	5.8	1.0	1.5	90	.038	.04
October	1.4	1.0	1.1	68	.028	.03
November	12	1.1	3.0	177	.074	.08
December	66	4.4	10.1	121	.252	.29
The year	1,250	1.0	25.6	18,200	.640	8.73

NOTE.—Discharges were obtained from several rating tables covering short periods of time. Values are fair.

SAN DIEGO RIVER NEAR LAKESIDE, CAL.

San Diego River has its headwaters on the west side of San Jacinto Mountains in the western portion of San Diego County, and flows in a southwesterly direction, discharging into the Pacific Ocean just north of San Diego city. This drainage basin lies just north of the Sweetwater drainage basin and south of the Santa Ysabel basin.

The extreme headwaters reach almost to the Santa Ysabel Indian Reservation on the north, and include the Cuyamaca reservoir. The topography of the basin is very rough, owing to numerous narrow canyons with small streams and mountain peaks, some of which have an elevation of 6,000 feet. The discharge is heavy in the spring and is of a torrential nature, but during the summer and fall there is no surface flow in the lower portion of the basin, the water disappearing in the sands 30 or 40 miles above San Diego city. The annual precipitation ranges from 10 to 20 inches near San Diego and from 20 to 30 or even 50 inches in the mountains, where some of it appears as snow. The formation is a loose granite and there is only a scrubby timber growth.

This station was established in December, 1905. It is located about 1 mile northwest of the Lakeside hotel and about three-fourths mile above the railroad station, on the road from Lakeside to Padre Barona Valley. It is 23 miles northeast of San Diego and is reached by the San Diego, Cuyamaca and Eastern Railway.

This station has a cable and car equipment, but, except in high stages, discharge measurements can always be made by wading. The bed of the stream is composed of a fine, shifting sand which supports no vegetation, and the channel is continually changing from side to side in low water. The left bank is high and rocky above the station and not liable to overflow, except below the measuring section. The right bank is composed of old river deposit and is subject to overflow above and below the station in very high stages. The channel is straight for 200 feet above and 250 feet below the station. The willow growth on right bank has been cleared away 20 feet above and below the cable. In low stages the quantity of water flowing on the surface depends on the saturation of the sand, and measurements will appear inconsistent, owing to the filling and scouring.

The gage consists of a 2 by 6 inch pine timber painted white and graduated to feet and tenths. It is on the left bank and is in two sections, a low and high water section, each bolted to granite bowlders.

The graduations extend from 2 to 7.8 feet.

The initial point for soundings is the head of a large nail on the left bank driven into a soft granite rock and painted yellow. 0. 0 in yellow paint is placed on the rock. A reference bench mark has been established on the top of the flat bowlder lying between the sycamore tree supporting the cable on the left bank and the bowlder used for an anchor. It is 8 feet downstream from station 20 of cable and is surrounded by a ring of white paint and has the assumed elevation of 400 feet marked on it. The zero of the gage is 7.77 feet below the bench mark, or at an elevation of 392.23 feet.

During 1906 the gage was read once a day by J. H. Lucas.

Discharge measurements of San Diego River near Lakeside, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 9	W. V. Hardy	3	0.7	2.67	0.4
January 24	do	25	8.3	3.04	12.5
February 6	do	6	1.2	2.90	1.3
February 12	do	53	24	3.20	42
February 20	do	53	25	3.28	45
February 22	do	56	42	3.54	100
February 22	do	55	39	3.50	92
February 22	do	54	30	3.40	67
March 9	do	35	12	3.10	17
March 13	do	63	123	4.50	714
March 13	do	73	166	4.80	995
March 14	do	63	75	4.10	280
March 15	do	53	60	3.90	201
April 7	do	63	75	4.50	403
April 17	do	58	57	4.25	183
April 21	do	57	39	4.15	98
April 24	do	57	47	4.07	130
April 30	do	56	46	4.25	186
May 1	do	55	37	3.92	96
May 9	do	56	30	3.86	62
May 12	do	55	36	3.94	89
June 20	C. H. Lee	16	2.6	3.45	2.8
August 8	R. S. Hawley	2	0.4	3.39	0.3
December 19	W. V. Hardy	......	......	3.30	[a] 1.0

[a] Estimated, water too shallow to measure.

Daily gage height, in feet, of San Diego River near Lakeside, Cal., for 1905–6.

Day.	1905.	1906.									
	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Dec.
1	......	2.66	2.90	3.32	4.9	4.2	3.8	3.45	3.4	3.35	......
2	......	2.66	2.91	3.26	4.75	4.15	3.75	3.45	3.4	3.35	......
3	2.60	2.66	2.91	3.20	4.65	4.0	3.75	3.45	3.4	3.35	......
4	2.60	2.67	2.91	3.20	4.6	3.95	3.75	3.45	3.4	3.35	3.35
5	2.60	2.68	2.92	3.28	4.5	3.9	3.7	3.45	3.4	3.3	3.3
6	2.60	2.68	2.98	3.18	4.5	3.95	3.7	3.45	3.4	3.3	3.3
7	2.60	2.68	3.02	3.12	4.5	3.9	3.7	3.4	3.4	3.3	3.3
8	2.60	2.68	3.12	3.11	4.55	3.85	3.65	3.4	3.4	3.3	3.3
9	2.60	2.68	3.02	3.10	4.45	3.85	3.65	3.4	3.4	......	3.35
10	2.62	2.67	3.12	3.08	4.4	3.8	3.65	3.4	3.4	......	3.35
11	2.62	2.66	3.15	3.08	4.35	3.85	3.6	3.4	3.4	......	3.3
12	2.63	2.65	3.18	3.20	4.35	3.85	3.6	3.4	3.4	......	3.4
13	2.63	2.65	3.18	4.50	4.25	3.9	3.6	3.4	3.4	......	3.6
14	2.63	2.66	3.20	4.10	4.2	3.85	3.6	3.4	3.4	......	3.4
15	2.63	2.66	3.28	3.96	4.2	3.8	3.55	3.4	3.4	......	3.3
16	2.63	2.67	4.00	4.05	4.2	3.8	3.55	3.4	3.4	......	3.3
17	2.63	2.67	3.64	4.65	4.2	3.8	3.5	3.4	3.4	......	3.3
18	2.64	2.67	3.48	4.36	4.2	3.75	3.5	3.4	3.4	......	3.3
19	2.64	2.74	3.41	4.25	4.15	3.8	3.5	3.4	3.4	......	3.3
20	2.66	3.91	3.28	3.94	4.1	3.75	3.5	3.4	3.4	......	3.3
21	2.66	3.40	3.26	3.88	4.15	3.75	3.5	3.4	3.4	......	3.35
22	2.66	3.35	3.54	3.84	4.1	3.75	3.5	3.4	3.4	......	3.3
23	2.65	3.68	3.48	3.90	4.1	3.75	3.5	3.4	3.4	......	3.3
24	2.65	3.07	3.38	5.58	4.05	3.75	3.5	3.4	3.4	......	3.3
25	2.65	3.00	3.24	7.00	4.05	3.75	3.45	3.4	3.4	......	3.3
26	2.65	2.96	3.22	6.88	4.0	3.75	3.45	3.4	3.35	......	3.35
27	2.67	2.92	3.18	5.80	4.0	3.85	3.45	3.4	3.35	......	3.4
28	2.67	2.92	3.18	5.42	4.05	3.75	3.5	3.4	3.35	......	3.8
29	2.67	2.92	......	5.14	4.2	3.95	3.5	3.4	3.35	......	4.15
30	2.66	2.91	......	4.96	4.25	3.85	3.5	3.4	3.35	......	3.8
31	......	2.90	......	4.99	......	3.8	......	3.4	3.35	......	3.75

NOTE.—The river was dry September 9 to December 3, 1906.

Monthly discharge of San Diego River near Lakeside, Cal., for 1906.

[Drainage area, 208 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	212	0.6	16.7	1,030	.080	.09
February	252	1.4	43.6	2,420	.210	.22
March	,800	15	683	42,000	3.28	3.78
April	890	105	277	16,500	1.33	1.48
May	170	39	65.7	4,040	.316	.36
June	51	2.8	15.1	898	.073	.08
July	2.8	.8	1.2	74	.0058	.007
August	.8	.4	.6	37	.0029	.003
September	.3	0	.1	6	.00048	.0005
October	0	0	0	0	.00	.00
November	0	0	0	0	.00	.00
December	152	0	11.0	676	.053	.06
The year	3,800	0	92.8	67,700	.446	6.08

NOTE.—Discharges were obtained by the indirect method for shifting channels. Values are fair.

BERNARDO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Bernardo River, or Santa Ysabel Creek, as it is known at its source, rises in the Volcan Range, on of the western ranges of San Jacinto Mountains, in the western part of San Diego County, at an elevation of 5,600 feet, and flows in a westerly direction through the San Pasqual Valley, below which it takes its true name and empties into the Pacific Ocean just north of the mouth of San Diego River. The upper part of this basin is on a loose granite formation and has a very rough topography, being cut up by numerous ravines in which small mountain streams flow continuously throughout the year. Below the mouth of the canyon, however, the surface flow of the Bernardo disappears in the sands of the San Pasqual Valley during the summer and fall.

The annual precipitation varies from 10 to 20 inches near San Diego, and from 20 to 30 or even 50 inches in the mountains, where some of it appears as snow. The heaviest discharge occurs in the spring, and is torrential in its nature. The drainage area above the mouth of the canyon where the gaging station is located is 128 square miles.

Measurements in this basin are useful for irrigation purposes.

SANTA YSABEL CREEK NEAR ESCONDIDO, CAL.

This station was established in December, 1905. It is located at the mouth of the canyon and at the head of the San Pasqual Valley, about 13 miles east of the town of Escondido. It is reached by driving up through the San Pasqual Valley from Escondido to Pott's ranch, the station being directly east of and only a few hundred feet from the ranch house.

This station is equipped with a cable and car, but it is only during very high water that they need to be brought into use, as measurements can be made by wading, except in flood. The bed is composed of fine sand and is constantly changing. The channel is straight for 150 feet above and 100 feet below the cable, and both banks are high and rocky and not liable to overflow at any stage. The grade is heavy above the section, so that high velocities are encountered in flood stages, and in extremely high water only float velocities can be taken.

The gage is a 2 by 4 inch timber painted white and graduated into feet and tenths. It is in one section and is bolted in an inclined position to a large granite bowlder on the left bank. It is located 15 feet downstream from station 175 of the cable, and the graduations extend from 2 to 8 feet.

The initial point for soundings is the head of the eyebolt sulphured into the large granite bowlder on the right bank. A reference bench mark has been established on the highest point of the bowlder to which the gage is bolted, 11 feet downstream from station 180 of cable. A circle of white paint indicates the point, and the assumed elevation of 500 feet is marked on the bowlder. The zero of the gage is 11.66 feet below the bench mark, or at an elevation of 488.34 feet.

During 1906 the gage was read once a day by S. F. Potts.

Discharge measurements of Santa Ysabel River near Escondido, Cal., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 21	W. H. Clapp	5	2.2	....	4.5
November 28	C. H. Lee	83	24	3.72	41
December 21	do	24	7.2	3.55	10.4
1906.					
January 10	W. V. Hardy	8	2.5	3.56	4.2
January 30	do	27	8.4	3.55	13.5
February 8	do	38	12.8	3.57	17.8
February 11	do	37	14.6	3.64	25
February 22	do	64	21	3.70	44
March 8	do	72	17.4	3.70	28
March 15	do	62	45	3.75	158
March 23	do	69	48	3.52	132
March 26	do	119	654	4.00	5,300
March 26	do	108	461	2.65	3,240
March 26	do	108	362	2.00	2,040
March 27	do	95	216	1.00	916
March 27	do	94	177	0.85	870
March 27	do	94	186	0.70	900
March 28	do	83	143	0.50	713
April 14	do	58	46	1.00	183
April 25	do	52	38	1.45	116
April 30	do	77	51	1.82	131
May 12	do	106	32	2.18	88
June 24	C. H. Lee	39	14	2.35	25
August 10	R. S. Hawley	10	2.8	2.45	3.7
October 3[a]	W. F. Martin	....	....	2.46	2.6
November 30	W. V. Hardy	16	6.4	2.54	15
December 7	do	15	6	2.64	10.8
December 20	do	15	7	2.70	10

[a] Stream flowing in several channels.

Daily gage height, in feet, of Santa Ysabel Creek near Escondido, Cal., for 1905-6.

Day.	1905.	1906.											
	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.55	3.5	3.7	0.7	1.85	2.4	2.4	2.4	2.45	2.45	2.5	2.55
2		3.5	3.5	3.65	0.9	1.85	2.4	2.4	2.45	2.45	2.45	2.5	2.6
3		3.55	3.5	3.65	0.7	1.8	2.4	2.35	2.4	2.45	2.45	2.5	2.6
4		3.45	3.5	3.7	0.7	1.8	2.35	2.4	(2.4)	2.4	2.45	2.5	2.6
5		3.55	3.5	3.7	0.75	1.9	2.35	2.35	2.35	2.45	2.4	2.5	2.65
6		3.6	3.65	3.65	0.55	1.95	2.35	2.4	2.4	2.45	2.4	2.5	2.6
7		3.55	3.6	3.65	0.4	1.95	2.35	2.4	2.4	2.5	2.45	2.5	2.65
8		3.55	3.55	3.7	0.45	1.95	2.3	2.4	2.4	2.4	2.45	2.4	2.7
9		3.5	3.6	3.65	0.7	2.0	2.3	2.35	2.4	2.45	2.45	2.5	2.7
10		3.55	3.5	3.7	0.7	2.0	2.35	2.4	2.45	2.45	2.4	2.45	2.7
11		3.55	3.65	3.7	0.7	2.0	2.3	2.35	2.4	2.5	2.4	2.45	2.7
12		3.6	3.6	4.2	0.9	2.2	2.3	2.35	2.4	2.5	2.4	2.45	3.0
13		3.6	3.6	4.5	0.9	2.2	2.3	2.4	2.4	2.5	2.4	2.5	2.7
14		3.6	3.6	3.75	1.0	2.15	2.3	2.4	2.4	2.5	2.4	[a]2.5	2.7
15		3.6	3.9	3.7	1.0	2.1	2.35	2.4	2.45	2.5	2.4	2.55	2.7
16		3.5	3.9	3.8	1.05	2.2	2.3	2.4	2.45	2.5	2.45	2.5	2.7
17	3.46	3.5	3.75	4.25	1.15	2.2	2.3	2.4	2.45	2.5	2.45	2.5	2.7
18	3.47	3.6	3.7	3.9	[a]1.15	2.2	2.25	2.4	2.5	2.5	2.5	2.5	2.7
19	3.47	3.85	3.7	3.65	[a]1.15	2.2	2.3	2.4	2.55	2.45	2.5	2.5	2.7
20	3.48	3.75	3.7	3.6	[a]1.15	2.15	2.3	2.4	2.45	2.4	2.5	2.5	2.7
21	3.54	3.6	3.65	3.55	[a]1.2	2.2	2.3	2.4	2.45	2.4	2.5	2.55	2.7
22	3.52	3.5	3.7	3.6	1.2	2.25	2.25	2.4	2.4	(2.4)	2.5	2.55	2.7
23	3.50	3.5	3.7	3.5	1.3	2.25	2.2	2.4	2.4	2.45	2.5	2.6	2.75
24	3.48	3.55	3.65	6.3	1.4	2.3	2.3	2.4	2.45	2.45	2.5	2.5	2.7
25	3.49	3.5	3.65	3.5	1.45	2.3	2.4	2.45	(2.4)	2.5	2.5	2.55	2.7
26	3.48	3.5	3.65	1.9	1.4	2.45	2.3	2.45	2.4	2.5	2.5	2.6	2.8
27	3.47	3.55	3.65	0.9	1.5	2.35	2.35	2.4	2.4	2.5	2.5	2.55	2.8
28	3.48	3.55	3.7	0.6	1.6	2.25	2.4	2.4	2.45	2.5	2.5	2.55	2.75
29	3.51	3.55		0.8	1.7	2.3	2.35	2.4	2.4	2.5	2.5	2.55	2.7
30	3.52	3.55		0.9	1.6	2.4	2.3	2.4	2.4	2.45	2.5	2.55	2.75
31	3.55	3.55		0.9		2.4		2.4	2.45		2.5		2.85

[a] Estimated.

Monthly discharge of Santa Ysabel Creek near Escondido, Cal., for 1906.

[Drainage area, 128 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	83	2	11.4	701	0.089	0.10
February	95	8	30.5	1,690	.238	.25
March	8,000	29	633	38,900	4.94	5.70
April	400	102	221	13,200	1.73	1.93
May	90	35	69.7	4,290	.545	.63
June	35	23	28.4	1,690	.222	.25
July	30	5	12.4	762	.097	.11
August	6	4	4.2	258	.033	.04
September	4	3	3.1	184	.024	.03
October	7	3	4.7	289	.037	.04
November	15	6	9.6	571	.075	.08
December	21	11	12.4	762	.097	.11
The year	8,000	2	86.7	63,300	.677	9.27

NOTE.—Discharges were obtained by the indirect method for shifting channels. Values are approximate.

SAN LUIS REY RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

San Luis Rey River rises on the western slope of the Coast Range in the northern portion of San Diego County, and flows in a westerly direction, discharging its waters into the Pacific Ocean near the town of Oceanside. It has numerous small tributaries, none of which have their sources at elevations above 5,000 feet. On the upper reaches of this stream the country is rolling, with several small valleys which are under cultivation, being used principally for the raising of grain and the pasturage of stock. At a point below what is known as the Warner's ranch reservoir site the river flows through a deep, narrow canyon with a heavy grade for a distance of about 10 miles. Below this point the grade is light, and the discharge is over a sandy and gravelly bed, where the water soon disappears, again rising in small quantities near the town of Pala, where the gaging station is located. Below the station it flows for a distance of about 25 miles on a light grade to the Pacific Ocean. There is a good soil covering throughout this basin, with a considerable growth of brush and grass, and with small areas of timber on the extreme higher elevations. The water is diverted at several points for irrigation, a considerable quantity being taken from the canyon above the gaging station and used in the vicinity of Escondido, which lies in an entirely separate drainage basin. This stream is torrential in its character, the discharge being very light except during the winter season, in times of heavy rainfall. The mean precipitation varies from 10 to 20 inches and falls principally in the form of rain, there being only a light fall of snow on the extreme higher elevations, which soon melts and only adds to the flood discharge.

SAN LUIS REY RIVER NEAR PALA, CAL.

This station was established October 9, 1903. It is located at Sickler's mill, 4 miles above Pala, Cal. It is reached by driving from Fallbrook or Temecula, stations on the Southern California Railway, 18 and 13 miles distant, respectively. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 91, where are given also references to publications that contain data for previous years. The datum of the gage was lowered 4.66 feet November 13, 1906.

Discharge measurements of San Luis Rey River near Pala, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 11	W. V. Hardy	10	6	0.60	9.0
January 28	do	12	8.3	0.18	14.7
February 9	do	12	5.5	0.13	10.4
February 26	do	19	8.6	0.66	17.9
March 4	do	22	14	1.02	38
March 4	do	22	16	1.10	43
March 5	do	22	18.8	1.20	48
March 6	do	20	14.	1.00	38
March 7	do	20	12.4	0.93	32
March 16	do	72	116	3.70	447
March 17	do	89	287	5.30	1,540
March 17	do	79	191	4.70	984
March 17	do	72	156	4.30	811
March 18	do	72	113	3.80	532
March 19	do	67	105	2.70	367
March 20	do	52	73	2.50	248
March 21	do	52	64	2.40	182
April 12	do	65	84	2.20	307
April 26	do	57	37	1.52	119
May 14	do	48	58	1.18	166
June 27	C. H. Lee	33	15	0.61	28
August 5	R. S. Hawley	11	3.8	0.30	5.9
October 10	W. F. Martin	15	2.8	....	3.0
November 13	W. V. Hardy	8	3.2	[a]5.27	3.5
December 5	do	25	9.0	[a]5.55	13
December 28	do	57	102	[a]7.15	322

[a] By new gage.

Daily gage height, in feet, of San Luis Rey River near Pala, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.75	0.1	0.8	3.35	1.6	1.1	0.5	0.5	0.2	0.2	......	5.6
2	.7	.1	.8	2.9	1.5	1.1	.5	.5	.2	.2	......	5.6
3	.7	.9	.8	2.55	1.4	1.1	.5	.5	.2	.2	......	5.55
4	.7	.9	1.0	2.5	1.4	1.1	.5	.5	.2	.2	......	5.55
5	.7	.15	1.2	2.75	1.5	1.1	.5	.5	.2	.2	......	5.55
6	.7	.2	1.0	3.0	1.45	1.05	.5	.5	.2	.2	......	5.55
7	.7	.3	.95	3.0	1.4	1.0	.5	.25	.2	.2	......	5.5
8	.7	.3	.7	3.05	1.3	1.0	.5	.3	.2	.2	......	5.5
9	.65	.25	.6	2.6	1.3	.9	.5	.25	.2	.2	......	5.5
10	.65	.2	.65	2.6	1.3	.85	.5	.25	.2	.2	......	5.45
11	.6	.65	.65	2.45	1.25	.8	.5	.3	.2	.2	......	5.4
12	6	.5	5.0	2.2	1.55	.7	.5	.25	.2	.2	......	7.8
13	.6	.4	6.55	2.15	1.4	.7	.5	.2	.2	.2	5.25	7.2
14	.7	.4	3.55	2.15	1.2	.65	.5	.2	.2	.2	5.25	6.5
15	.7	.8	2.3	2.15	1.15	.6	.5	.2	.5	.2	5.25	5.8
16	.7	2.65	2.85	2.05	1.1	.6	.5	.2	.35	......	5.25	5.8
17	.65	.85	4.8	2.05	1.05	.85	.5	.2	.2	......	5.25	5.7
18	.65	.95	3.65	1.95	1.0	.8	.5	.8	.2	......	5.25	5.65
19	1.0	.85	2.95	1.95	1.0	.7	.5	.7	.2	......	5.25	5.6
20	2.6	.75	2.5	1.85	.95	.6	.5	.6	.2	......	5.25	5.55
21	1.2	.9	2.4	1.8	1.0	.6	.5	.5	.2	......	5.25	5.55
22	.9	.95	2.5	1.75	.9	.65	.5	.3	.2	......	5.5	5.5
23	.6	1.0	2.5	1.75	.9	.6	.5	.25	.2	......	5.65	5.5
24	.3	.95	10.0	1.65	.9	.55	.5	.25	.2	......	5.6	5.45
25	.3	.9	7.0	1.6	.9	.5	.5	.2	.2	......	5.6	5.4
26	.25	.6	7.25	1.5	1.25	.5	.5	.2	.2	......	5.6	5.8
27	.2	.6	4.6	1.45	1.5	.5	.5	.2	.2	......	5.7	6.6
28	.18	.9	4.4	1.7	1.7	.5	.5	.2	.2	......	5.6	6.7
29	.15	......	4.1	1.7	1.5	.5	.5	.2	.2	......	5.6	6.8
30	.15	......	3.35	1.6	1.3	.5	.5	.2	.2	......	5.6	6.6
31	.15	......	4.0	......	1.25	......	.5	.2	......	......	......	6.7

NOTE.—Gage heights after November 13 are by the new gage, the datum of which is 4.06 feet below that of the old gage.

Monthly discharge of San Luis Rey River near Pala for 1906.

[Drainage area, 318 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	232	9	21.4	1,320	0.067	0.08
February	241	10	28.6	1,590	.090	.09
March	13,000	17	1,120	68,900	3.52	4.06
April	620	114	301	17,900	.947	1.06
May	260	100	158	9,720	.497	.57
June	128	19	65.6	3,900	.206	.23
July	19	19	19.0	1,170	.060	.07
August	43	3	10.3	633	.032	.04
September	19	3	3.7	220	.012	.01
October	3	3	3.0	184	.0094	.01
November	28	3	8.3	494	.026	.03
December	550	9	79.3	4,880	.249	.29
The year	13,000	3	152	111,000	.476	6.54

NOTE.—Discharges were obtained by the indirect method for shifting channels. Values are fair.

SANTA MARGARITA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Temecula Creek, as Santa Margarita River is known at its beginning, rises on the western slope of the San Jacinto Mountains in the northwestern part of San Diego County just north of the San Luis Rey drainage basin, flows north into Riverside County, then west about 15 miles to Temecula, where it flows southwest through Temecula Canyon into San Diego County and empties into the Pacific Ocean as Santa Margarita River. The highest elevation in the basin is about 5,500 feet on the divide between Temecula and San Luis Rey. Temecula Creek has few tributaries, and the topography is rather broken, though there are several small valleys in the upper reaches. The rock formation through which it flows is a loose granite with good soil covering, and there is considerable growth of small, scrubby timber. The annual precipitation varies from 10 to 30 inches and occurs almost entirely as rain. The discharge is quite heavy in the spring during the flood season, but is small during the rest of the year.

Measurements are useful in connection with irrigation.

TEMECULA CREEK NEAR TEMECULA, CAL.

This station was established December 30, 1905. It is located about 1½ miles south of the town of Temecula at the bridge on the road from Temecula to Pala and Fallbrook. It is reached by driving from Temecula.

The channel is straight for 500 feet above and 100 feet below. The bed is shifting sand and the channel is continually changing, being usually in two channels at low water. Neither bank is liable to overflow at any stage.

During low water, discharge measurements are made by wading below the bridge. High-water measurements are made from the downstream side of the bridge.

The gage, which during 1906 was read once a day by Hugh McConville, is a 2 by 6 inch timber fastened to the downstream pier nearest to the right bank by two pieces of strap iron. It is in one vertical section, painted white, and graduated into feet and tenths. The graduations run from 0.0 to 10 feet. Marks 10 feet apart are put on the bridge rail in yellow paint for use in soundings. The bench mark is a nail in the base of a willow tree on the right bank of the river below the bridge; elevation, 8.13 feet above the zero of the gage.

Discharge measurements of Temecula River near Temecula, Cal., in 1905-6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 14	W. B. Clapp	11	5.4	3.10	5.8
December 30	W. V. Hardy	9	3.5	2.98	4.6
1906.					
January 12	W. V. Hardy	8	3.3	2.90	4.4
January 29	do	8	4.0	2.94	4.9
February 10	do	10	4.1	2.99	4.4
February 24	do	16.5	7.7	3.20	3.3
March 5	do	12	10.3	3.49	6.0
March 6	do	12.	9.3	3.42	5.4
March 18	do	36	18.0	3.82	16.8
March 19	do	27	11.9	3.69	12.0
April 13	do	65	16.0	5.84	12.1
April 27	do	11	4.1	5.82	5.6
May 15	do	15	5.0	5.88	6.4
June 26	C. H. Lee	11	2.1	5.80	2.6
August 5	R. S. Hawley	3	0.8	......	0.8
October 10	W. F. Martin	16	2.5	......	3.9
November 12	W. V. Hardy	14.5	5.7	5.80	7.6
December 4	do	10	4.4	6.00	7.2
December 29	do	12	6.0	6.10	14.9

Daily gage height, in feet, of Temecula River near Temecula, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Dec.
1	3.0	2.9	3.4	5.9	5.75	5.8	5.8	......
2	3.0	2.8	3.5	5.8	5.7	5.8	5.8	......
3	3.0	2.8	3.5	5.8	5.7	5.8	5.8	6.0
4	3.0	2.8	3.45	5.8	5.7	5.8	5.8	6.0
5	3.0	2.8	3.45	6.7	5.75	5.8	5.8	6.0
6	3.0	2.8	3.5	6.3	5.75	5.8	5.8	6.0
7	3.0	2.8	3.5	5.8	5.75	5.8	5.8	5.9
8	3.0	2.9	3.55	5.8	5.75	5.8	5.8	5.9
9	2.9	2.95	3.5	5.8	5.75	5.8	5.8	5.9
10	2.9	2.95	3.6	5.8	5.75	5.8	5.8	5.9
11	2.9	3.0	3.9	5.8	5.75	5.75	5.8	5.9
12	2.9	3.0	4.9	5.8	5.7	5.7	5.8	6.0
13	2.9	3.0	5.0	5.8	5.7	5.75	5.8	6.0
14	2.9	3.0	4.9	5.8	5.7	5.8	5.8	5.9
15	2.9	3.0	4.9	5.8	5.7	5.75	5.8	5.9
16	2.9	3.2	3.7	5.8	5.8	5.75	5.8	5.95
17	2.9	3.2	3.7	5.8	5.85	5.75	5.8	6.0
18	2.9	3.25	3.65	5.8	5.85	5.75	......	6.0
19	3.1	3.25	3.65	5.75	5.85	5.75	......	5.9
20	3.0	3.25	3.5	5.75	5.85	5.75	......	5.9
21	3.0	3.25	3.3	5.75	5.85	5.75	......	5.9
22	3.0	3.25	3.4	5.75	5.9	5.75	......	5.9
23	3.0	3.25	9.6	5.75	5.9	5.75	......	5.95
24	3.0	3.25	9.65	5.75	5.85	5.75	......	5.9
25	3.0	3.25	8.0	5.75	5.85	5.75	......	......
26	3.0	3.3	7.6	5.75	5.9	5.8	......	6.2
27	2.9	3.4	6.0	5.75	5.85	5.8	......	6.0
28	2.9	3.4	5.5	5.75	5.8	5.8	......	6.2
29	2.9	......	5.5	5.75	5.8	5.8	......	6.05
30	2.9	......	5.9	5.75	5.8	5.8	......	6.1
31	2.9	......	5.9	......	5.8	......	......	6.25

NOTE.—No gage height record was kept from July 18 to December 2. Discharges have not been computed on account of the small number of measurements at times of excessive changes in channel.

SANTA ANA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Santa Ana River has its source in the southern slope of the San Bernardino Mountains. It traverses the San Bernardino Valley in a southwesterly direction, breaks in a narrow canyon through the Santa Ana Mountains, and finally discharges through the Santa Ana Valley into the Pacific Ocean below the town of Santa Ana. Numerous tributaries rise in the southern slope of the San Bernardino Mountains, the surface flow of most of which reaches Santa Ana River, where it traverses San Bernardino Valley only in times of flood discharge. The topography on the higher elevations is rough and rugged, reaching elevations of from 10,000 to 12,000 feet, the formation being of granite with good soil covering and considerable growth of timber. On the lower elevations the topography is less rough and the soil covering is principally of brush. A gaging station is located on this stream at Warm Springs, about 8 miles above Redlands. Below this the river leaves the mountainous country and discharges over a sandy and gravelly bed through the San Bernardino Valley. During the summer months the entire flow of the stream is diverted above this gaging station and used for power development at the mouth of the canyon, below which point it is again taken out and used for irrigation on the higher elevations of the San Bernardino Valley along the base of the mountains, where the country is under a high state of cultivation, principally for the raising of citrus fruits. The water rises to the surface in San Bernardino Valley near the city of San Bernardino and is diverted and used extensively for irrigation in the neighborhood of Riverside. In addition to this surface flow, a large number of wells have been sunk in this territory, many of which are artesian, while others require pumping. This developed water is also used extensively for irrigation in the vicinity of San Bernardino and Riverside. The water is again forced to the surface by bed-rock obstructions at Riverside Narrows below the city of Riverside, and gradually increases in volume until it reaches Santa Ana Canyon, where it is diverted for irrigation on the lower valley lands in the vicinity of Santa Ana and Fullerton. During the summer months measurements are made of the flow at Rincon, Cal., at the head of Santa Ana Canyon. There are only occasional flood discharges of this river which flow continuously from the mountain to the sea. The mean precipitation throughout this basin is from 15 to 30 inches, which falls in the form of rain except on the higher elevations of the San Bernardino Mountains, where there is a considerable snowfall, usually remaining on the extreme high elevations until midsummer. A storage reservoir has been constructed on Bear Creek, a tributary of this stream, and is known as the Bear Valley reservoir. This stored water is held until the summer months and used for irrigation in the San Bernardino Valley.

SANTA ANA RIVER NEAR MENTONE, CAL.

This station was established in June, 1896. It is located 5 miles northeast of Mentone, Cal., three-fourths of a mile below the head works of the Mentone Power Company's canal and opposite the warm springs in the canyon.

The Edison Electric Company diverts the greater portion of the water from Santa Ana River above the gaging station, but also returns all of it above the station. They, however, allow only limited portions of the water to pass out of their conduits during certain hours of the day, holding back the water for the purpose of obtaining additional power when the greatest demand exists.

The Mentone Power Company's canal, formerly called the Santa Ana canal, diverts water above the station, all of which is returned below the point of measurement. During the low-water season the entire flow of the river is diverted by the canals. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 94, where are given also references to publications that contain data for previous years.

Discharge measurements of Santa Ana River near Mentone, Cal., in 1906.

Date.	Hydrographer.	Gage height of river.	Discharge.		
			River.	Mentone Power Company's canal.	Total for river.
		Feet.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
January 20	C. H. Lee	2.17	87	37	124
February 11	do	1.51	11	42	53
February 11	do	1.57	15.8	42	58
February 11	do	1.54	12.8	42	55
February 12	do	1.45	6.7	52	59
March 14	do	3.50	351	27	378
March 16	do	5.40	1,410	49	1,460
March 16	do	5.80	1,870	49	1,920
March 17	do	4.15	677	0	677
March 17	do	3.85	597	0	597
March 18	do	3.70	405	11	416
March 23	M. P. Beeson	3.05	156	55	211
March 25	do	4.90	913	35	948
March 26	do	6.35	2,250	34	2,280
March 26	do	5.90	1,780	34	1,810
March 27	do	5.25	1,200	25	1,220
April 10	C. H. Lee	3.00	130	68	198
April 21	M. P. Beeson	3.50	214	72	286
May 12	do	3.60	148	71	219
May 12	do	3.60	160	71	231
June 2	do	3.50	149	66	215
June 28	do	3.00	70	71	141
August 4	R. S. Hawley	2.55	13.1	72	85
October 11	W. F. Martin	2.31	2.9	61	64
December 28	do	3.85	276	74	350

Daily gage height, in feet, of Santa Ana River near Mentone, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	1.3	1.9	3.9	3.1	4.0	3.0	2.6	2.3	2.5	2.3	2.3
2	1.3	1.3	1.9	3.4	3.0	3.5	3.0	2.6	2.3	2.5	2.3	2.3
3	1.3	1.3	1.7	3.3	2.9	3.5	2.9	2.5	2.3	2.5	2.3	2.4
4	1.3	1.3	1.6	3.4	2.9	3.3	2.9	2.5	2.3	2.5	2.3	2.7
5	1.3	1.3	1.5	3.4	3.6	3.3	3.0	2.4	2.3	2.5	2.3	2.7
6	1.3	1.3	1.5	3.3	3.7	3.3	3.0	2.4	2.3	2.5	2.3	2.3
7	1.3	1.3	1.4	3.2	3.4	3.2	3.0	2.4	2.2	2.5	2.3	2.3
8	1.3	1.3	1.4	3.1	3.8	3.2	3.0	2.4	2.2	2.5	2.3	2.3
9	1.3	1.3	1.4	3.0	3.8	3.2	2.9	2.4	2.2	2.5	2.3	2.3
10	1.3	1.3	1.4	3.0	3.8	3.2	2.9	2.4	2.2	2.5	2.3	2.3
11	1.3	1.3	1.4	3.0	3.8	3.4	2.9	2.4	2.2	2.5	2.3	2.3
12	1.3	1.3	6.5	2.9	3.6	3.2	2.9	2.4	2.2	2.5	2.3	5.2
13	1.3	1.3	4.5	2.9	3.6	3.2	2.9	2.6	2.2	2.5	2.3	3.2
14	1.3	1.3	3.4	3.0	3.4	3.2	2.9	2.6	2.2	2.5	2.3	2.9
15	1.3	1.3	3.0	2.9	3.3	3.2	2.9	2.5	2.2	2.5	2.3	2.3
16	1.3	1.3	5.0	2.9	3.3	3.2	3.0	2.6	2.3	2.5	2.3	2.4
17	1.3	1.3	4.15	2.9	3.2	3.1	2.9	2.9	2.3	2.5	2.3	2.4
18	1.3	1.3	3.7	2.9	3.2	3.1	2.9	3.0	2.3	2.5	2.3	2.2
19	2.1	1.3	3.45	2.9	3.2	3.1	2.8	2.7	2.3	2.5	2.3	2.2
20	2.2	1.3	3.25	3.0	3.2	3.1	2.8	2.6	2.3	2.5	2.3	2.0
21	1.7	1.3	3.15	3.5	3.2	3.1	2.7	2.5	2.3	2.3	2.3	2.0
22	1.5	1.9	3.1	3.8	3.4	3.1	2.8	2.4	2.5	2.3	2.3	2.0
23	1.5	2.0	3.05	3.9	3.5	3.1	2.8	2.3	2.5	2.3	2.3	2.0
24	1.4	2.0	4.6	3.9	3.5	3.4	2.9	2.1	2.5	2.3	2.3	2.0
25	1.4	2.0	4.95	3.7	3.2	3.1	2.8	2.0	2.5	2.3	2.3	2.0
26	1.3	2.0	5.8	3.7	3.2	3.0	2.8	2.3	2.5	2.3	2.3	2.0
27	1.3	2.0	5.2	3.1	3.3	3.1	2.8	2.3	2.5	2.3	2.3	3.2
28	1.3	2.0	4.9	3.3	4.9	3.1	2.7	2.3	2.5	2.3	2.3	3.5
29	1.3	......	4.6	3.8	4.4	3.0	2.7	2.3	2.5	2.3	2.3	3.5
30	1.3	......	4.3	3.8	4.3	3.0	2.7	2.3	2.5	2.3	2.3	2.1
31	1.3	......	4.2	......	4.0	......	2.6	2.3	......	2.3	......	2.8

Daily discharge, in second-feet, of Mentone Power Company's canal near Mentone, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	34	32	51	0	70	71	71	72	63	64	67	62
2	33	32	48	56	71	66	66	72	58	64	60	61
3	34	32	48	55	71	70	71	72	58	64	60	70
4	34	32	43	57	71	71	71	72	63	63	62	71
5	34	32	56	56	71	70	71	72	63	63	64	71
6	34	35	52	52	71	70	71	72	63	63	66	72
7	34	35	51	65	71	70	71	71	66	61	66	67
8	34	35	50	70	70	70	71	68	64	61	56	60
9	34	44	50	70	72	70	71	70	63	61	60	60
10	34	41	50	68	71	70	71	71	62	61	60	68
11	33	42	46	73	66	70	71	71	62	61	60	61
12	34	52	43	74	71	70	71	71	62	61	60	59
13	35	59	40	74	66	71	71	71	59	61	58	74
14	45	55	27	66	63	71	71	72	60	61	54	72
15	44	63	43	66	66	71	71	72	64	61	57	72
16	44	62	49	66	66	71	71	72	63	61	54	65
17	37	64	0	68	66	70	71	45	58	61	54	68
18	37	51	11	68	68	70	71	42	58	64	56	65
19	59	49	35	71	70	71	71	72	56	63	56	65
20	37	48	44	72	70	71	71	72	56	63	54	59
21	48	48	43	72	66	70	71	72	57	67	57	59
22	50	60	58	71	71	72	71	72	54	67	53	59
23	37	58	55	71	71	71	71	72	52	67	53	56
24	37	56	71	71	71	71	71	72	52	67	53	61
25	41	55	35	70	66	71	72	72	52	67	52	59
26	38	53	34	71	66	66	72	70	52	67	52	76
27	35	51	25	71	64	64	72	70	59	66	59	74
28	35	49	55	71	0	71	72	66	62	64	56	74
29	33	......	34	71	66	71	72	66	63	68	57	74
30	33	......	21	71	66	71	72	65	64	67	62	73
31	33	......	27	......	64	......	72	66	......	67	......	74

Monthly discharge of Santa Ana River near Mentone, Cal., for 1906.

[Drainage area, 182 square miles.]

Month.	Discharge in second-feet			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	181	34	46.8	2,880	0.257	0.30
February	121	33	63.1	3,500	.347	.36
March	2,440	51	530	32,600	2.91	3.36
April	495	186	274	16,300	1.50	1.67
May	536	163	245	15,100	1.35	1.56
June	329	135	172	10,200	.945	1.05
July	140	90	119	7,320	.654	.75
August	111	67	80.5	4,950	.442	.51
September	74	58	64.1	3,810	.352	.39
October	74	66	71.4	4,390	.392	.45
November	69	54	60.3	3,590	.331	.37
December	859	56	111	6,820	.610	.70
The year	2,440	33	153	111,000	.841	11.47

NOTE.—The discharge includes that of the Mentone Power Company's canal. Discharges for the river were obtained from rating tables covering short periods of time on account of the constant change in channel. Values are fair.

SEEPAGE MEASUREMENTS.

In the vicinity of Colton and San Bernardino large quantities of water are developed in addition to the natural surface flow. This water is used for the irrigation of land in the vicinity of San Bernardino, Colton, and Riverside, and also for domestic supply for these towns. Much of this water returns to Santa Ana River below Riverside, above a point known as Slover Mountain, and is again diverted and used for irrigation on the lower lands below Riverside and above what is known as Riverside Narrows. Below this point there are still further diversions which irrigate the lower lands along the river bottom, much of this water again returning to the river above Rincon. Measurements were made during the summers of 1905 and 1906 to determine the amount of water, including the natural flow and developed water, above Colton, Cal. Also measurements were made of natural flow and developed water below Slover Mountain and above Riverside Narrows, this all being return water from irrigated lands on the higher elevations. Measurements were also made of diversion ditches and Santa Ana River below Riverside Narrows and above what is known as the Auburndale Bridge. The following tabulations show the result of these measurements, which were made by K. Sanborn, of Riverside, Cal.

Measurements made during 1905 are contained in Water-Supply Paper No. 177, pages 99 to 102.

Natural flow, in second-feet, of return water to Santa Ana River, compared with developed water in San Bernardino above Colton, Cal., 1906.

[Measurements by Kingsbury Sanborn, engineer Riverside Water Company.]

Date.	Location.	Developed.	Natural.	Total.
June 23	Barnhill pumping plant	1.30		1.30
August 27	do	1.50		1.50
June 18	Beam ditch		0.00	.00
August 23	do		.00	.00
June 20	Bloomington pumping plant	10.50		10.50
September 20	do	6.70		6.70
September 20	Citizens Water Co. pumping plant	1.50		1.50
June 29	City of San Bernardino, Sixth street pumping plant	2.00		2.00
October 23	do	4.80		4.80
June 20	City of San Bernardino, Lytle Creek		1.90	1.90
September 20	do		2.00	2.00
June 19	City of Colton pumping plant (total)	2.40		2.40
August 27	do	3.50		3.50
June 19	City of Colton (water used for irrigating)	.70		.70
August 27	do	1.60		1.60
June 20	Camp Carlton ditch	2.70		2.70
September 7	do	1.94		1.94
June 19	Carr pumping plant	.40		.40
August 24	do	.70		.70
June 25	Daley ditch		.00	.00
October 24	do		.00	.00
June 27	Excelsior Land and Water Co	.60		.60
August 24	do	.75		.75
June 19	Grand Terrace pumping plant	.30		.30
September 7	do	.35		.35
June 20	Gage Canal, Palm avenue weir	22.90	8.30	31.20
September 7	do	38.00		38.00
June 19	Gage Canal intake, Santa Ana River		8.30	8.30
September 7	do		.00	.00
June 14	Haws & Talmadge ditch		.05	.05
August 23	do		.08	.08
June 19	Hunter pumping plant	1.90		1.90
August 27	do	1.50		1.50
June 23	Johnson & Hubbard pumping plant	.52		.52
August 27	do	.48		.48
June 23	Lamb pumping plant	.00		.00
August 27	do	.00		.00
June 23	Lawson Well Co. pumping plant	.60		.60
August 27	do	.70		.70
June 18	Logsdon & Farrell ditch		.00	.00

Natural flow, in second-feet, of return water to Santa Ana River, compared with developed water in San Bernardino above Colton, Cal., 1906—Continued.

Date.	Location.	Developed	Natural.	Total.
October 24	Logedon & Farrell ditch		0.00	0.00
June 20	Lytle Creek Water and Improvement Co pumping plant.	0.00		.00
September 20	do	.00		.00
June 28	Merryfield pumping plant	.80		.80
August 24	do	.79		.79
June 18	McKenzie ditch		.00	.00
August 23	do		.00	.00
June 28	Meeks & Daley ditch		16.90	16.90
August 31	do		17.10	17.10
June 22	McIntyre ditch		.00	.00
September 20	do		.00	.00
June 21	Orange Land and Water Co. pumping plant	.00		.00
August 27	do	.00		.00
June 20	Riverside Highland Water Co. pumping plant	3.40		3.40
September 20	do	6.10		6.10
June 20	Riverside Highland Water Co., Santa Ana River	1.80	2.50	4.30
September 7	do	6.90		6.90
June 20	Rancheria pumping plant	2.00		2.00
September 20	do	1.90		1.90
June 14	Rabel ditch		.00	.00
August 23	do		.00	.00
June 19	Riverside Water Co., upper canal	2.90	38.60	41.50
August 31	do	23.65	26.35	50.00
June 23	Riverside Water Co. mill pumping plant	.00		.00
August 31	do	.00		.00
June 20	Riverside Water Co. flume		16.70	16.70
August 31	do		.00	.00
June 25	Riverside Water Co. flume pump No. 1	.00		.00
August 31	do	.00		.00
June 25	Riverside Water Co. flume pump No. 2	.00		.00
August 31	do	.00		.00
June 28	Rosedale Water Co pumping plant	.50		.50
August 24	do	.00		.00
June 19	Rogers pumping plant	1.60		1.60
September 7	do	2.40		2.40
June 25	Shay or Stout Dam ditch		.00	.00
August 23	do		.24	.24
June 23	Swamp ditch		.80	.80
August 29	do		.64	.64
June 27	West Riverside 350-inch Water Co. pumping plant	6.00		6.00
August 31	do	6.50		6.50
June 22	Whitlock ditch		.00	.00
October 24	do		.00	.00
October 24	Whiting ditch		.00	.00
June 20	Ward and Warren ditch		5.10	5.10
September 7	do		.06	.06

Return waters, in second-feet, in San Bernardino Valley below Slover Mountain and above Riverside Narrows, 1906.

[Measurements by Kingsbury Sanborn, engineer Riverside Water Company.]

Date.	Location.	Developed	Natural.	Total.
June 27	Alvitrez ditch at headgate, east end of West Riverside Bridge		5.20	5.20
August 28	do		5.00	5.00
June 29	Cuttle's pumping plant	2.50		2.50
September 7	do	2.50		2.50
June 29	California Orange Co	1.30		1.30
September 7	do	1.40		1.40
June 29	Evans Island or Jansen ditch, under west end of West Riverside Bridge.		.00	.00
September 3	do		.00	.00
June 26	Evans ditch near county line		1.90	1.90
September 3	do		.00	.00
June 23	Evans Well ditch, Santa Ana street		.00	.00
September 3	do		.00	.00
June 29	Evans pipe line to China garden at headworks		.00	.00
September 13	do		2.70	2.70
June 27	Evans pumping plant 1,000 feet south of west end of West Riverside Bridge.	3.60		3.60
August 28	do	5.53		5.52
June 29	Evans Jurupa pumping plant	.00		.00
June 30	Ferris Gallagher ditch, near headworks		2.90	2.90
September 13	do		3.25	3.25
June 30	Gallagher ditch, near headworks		.76	.76
September 13	do		.00	.00

Return waters, in second-feet, in San Bernardino Valley below Slover Mountain and above Riverside Narrows, 1906*—Continued.

Date.	Location.	Developed.	Natural.	Total.
June 26	Jurupa pumping plant to supply Rubidoux ditch	2.30		2.30
September 3	do	5.20		5.20
June 27	Lower canal, Riverside Water Co		3.10	3.10
September 3	do		.00	.00
June 29	Pond's pumping plant	1.30		1.30
September 7	do	2.50		2.50
June 26	Rubidoux ditch at measuring box		4.40	4.40
September 3	do		2.00	2.00
June 21	Riverside Power Co. canal at Pedley crossing		27.70	27.70
September 20	do		35.00	35.00
June 20	Rivino Land Co. pumping plant No. 1	.86		.86
September 7	do	.70		.70
September 13	Rivino Land Co. pumping plant No. 2	.83		.83
June 25	Smith or Evans ditch 1 mile below Riverside County line		1.70	1.70
September 3	do		.00	.00
June 27	Soquel ditch at intake		6.60	6.60
August 28	do		5.30	5.30
June 23	Spring Brook pumping plant at weir at end of main	.00		.00
September 3	do	.00		.00
June 26	Spanishtown pumping plant at weir at end of main	4.00		4.00
September 3	do	.00		.00
June 30	Zimmerman pipe line		2.20	2.20
September 13	do		.00	.00

Discharge measurements, in second-feet, of canals between Riverside Narrows and the Auburndale Bridge having their source in Santa Ana River, 1906.

Date.	Location.	Discharge
June 21	Castile ditch near intake	0.00
September 29	do	.00
June 21	Durkee ditch at Auburndale road crossing	3.20
September 29	do	3.50
June 21	Fuller ditch	12.70
September 29	do	6.70
June 21	Gilliland ditch at Auburndale road crossing	.17
September 29	do	.50
June 21	Newton ditch near intake	.00
September 29	do	.00
June 21	Newberry ditch at Auburndale road crossing	.00
September 29	do	1.00
June 21	Roberts or LeGay ditch near intake, Santa Ana River	2.40
September 29	do	1.50
June 21	Wilbur ditch at Rogers pipe trestle crossing, Santa Ana River	.00
September 29	do	.00
June 21	Santa Ana River at Auburndale Bridge	56.00
September 29	do	52.00
June 21	Santa Ana River at Auburndale Bridge, including ditches	59.37
September 29	do	57.00

MISCELLANEOUS MEASUREMENTS IN SANTA ANA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the Santa Ana River drainage basin during 1906.

Cable Canyon Creek near Glen Helen, Cal.—This stream is a tributary of the Santa Ana River. A measurement was made July 16, 1906, at the diversion weir in the canyon:

Diversion over weir, 1.1 second-feet; waste below weir, 2.1 second-feet; total flow of creek, 2.2 second-feet.

Cajon Creek near Keenbrook, Cal.—This stream is a tributary of Lytle Creek. A measurement was made July 16, 1906, in the canyon at Keenbrook:

Width, 3 feet; area, 1.3 square feet; discharge 3.3 second-feet.

Chino Creek near Rincon, Cal.—This stream is a tributary of Santa Ana River. The following measurements were made during 1906, at the wagon bridge at Rincon road crossing, one-fourth mile above junction with Santa Ana River:

June 25: Width, 3 feet; area, 1.5 square feet; discharge, 3.9 second-feet.
August 31: Width, 3.5 feet: area, 1.3 square feet; discharge, 2.6 second-feet.
November 7: Width, 5.5 feet; area, 6.2 square feet; discharge, 10.3 second-feet.

Devil Canyon Creek near Irvington, Cal.—This stream is a tributary of Santa Ana River. A measurement was made July 14, 1906, at the mouth of the canyon:

Width, 4 feet; area, 2.4 square feet; discharge, 5.2 second-feet.

East Twin Creek near Arrowhead Springs, Cal.—This stream is a tributary of the Santa Ana River. A measurement was made July 14, 1906, in the canyon above the canal diversion:

Width, 2 feet; area, 1.8 square feet; discharge, 2.7 second-feet.

Lytle Creek near Rialto, Cal.—This stream is one of the principal tributaries of Santa Ana River. A measurement was made July 16, 1906, at the head of the Foutella Development Company's canal at the mouth of the canyon:

Diversion over weir, 25.4 second-feet; waste below weir, 56 second-feet; total flow of creek, 81.4 second-feet.

Santa Ana River near Rincon, Cal.—The following measurements were made during 1906, at the Rincon wagon bridge, at the lower end of the San Bernardino Valley and at the head of the lower Santa Ana Canyon. These measurements, with the addition of those of Chino Creek, show the total discharge of Santa Ana River below all diversions in the San Bernardino Valley, and show the amount of water used for irrigation in the vicinity of Orange, Santa Ana, Anaheim, and Fullerton, Cal., diversions being made below this point of measurement:

June 25: Width, 47 feet; area, 40 square feet; discharge, 82 second-feet.
August 3: Width, 47 feet; area, 33 square feet; discharge, 56 second-feet.
November 7: Width, 43 feet; area, 45 square feet; discharge, 94 second-feet.

Waterman Canyon or West Twin Creek near Arrowhead Springs, Cal.—This stream is a tributary of Santa Ana River. A measurement was made July 14, 1906, at the crossing on the road to Waterman Ranch near the mouth of the canyon:

Width, 4.7 feet; area, 3.6 square feet; discharge, 4 second-feet.

SAN GABRIEL RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

San Gabriel River rises in the Sierra Madre Mountains and, flowing in a southwesterly direction through the San Gabriel and Los Angeles valleys, discharges its waters into the Pacific Ocean near Long Beach, Cal. In the upper reaches of this basin there are numerous tributaries, which have their source in the higher elevations of the Sierra Madre Range. The topography in the upper reaches of this basin is rough and rugged, with deep and narrow canyons, while on the lower elevations the country is rolling, with large areas of valley land. The formation on the higher mountain elevation is of granite, with a light soil covering, with sparse timber growth. As one approaches the middle elevations the covering is brush, with scattering timber, while in the foothill country there is nothing but a growth of grass. The gaging station on this stream is located at a point where the stream leaves the higher mountains in the vicinity of Azusa. Below this point the river enters the San Gabriel Valley, where the stream has a comparatively light grade, the bed being composed of bowlders, gravel, and sand, in which the water quickly disappears, except in times of flood discharge. The waters of this stream again appear on the surface at the lower end of the San Gabriel Valley, at the point of discharge from the foothills, where an obstruction to the underground passage forces the water to the surface, on which it flows for a short distance and again disappears in the sands of the flat country below the foothills. The entire flow of this stream during the summer months is diverted at a point about 5 miles above the gaging station and is used for power purposes at the mouth of the canyon. From this point it is carried in ditches and used for irrigation in the San Gabriel Valley. The water is again diverted where it appears on the surface at the lower end of this valley and is used for irrigation on the lower levels below this point. The mean precipitation in this basin varies from 15 to 30 inches and is principally in the form of rain. On small areas in the higher mountain elevations the precipitation is in the form of snow, which melts in the early spring months.

SAN GABRIEL RIVER AND CANALS NEAR AZUSA, CAL.

Owing to the numerous diversions, it has been difficult to obtain accurate discharge measurements at Azusa, but during 1898 the San Gabriel Electric Company completed its system, and measurements are now obtained with greater ease and hence with greater accuracy. The head works of this company are located about 6 miles above the mouth of the canyon. The water is carried around the left side by a series of tunnels and conduits, and a head of 400 feet is obtained where the electric power is generated. Weirs are placed on the conduit of the electric company and the water is measured at this point. The capacity of the conduit is 80 second-feet.

The cable and gage are located about 1 mile from Azusa. During the season of low water for a period of from six to eight months the canals above the station divert the entire flow and there is no running water at the station. The total flow of the river is obtained by adding the daily discharge for the river to the figures for the corresponding dates for the canals. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 104, where are given also references to publications that contain data for previous years.

Discharge measurements of San Gabriel River and canals near Azusa, Cal., in 1906.

Date.	Hydrographer.	Gage height.	Discharge.		
			River.	Canal.	Total.
		Feet.	*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
January 19	M. P. Beeson	3.88	375	0	375
January 20	do	2.90	104	76	180
January 20	do	2.95	110	76	186
February 10	do	1.70	3.5	57	60
February 15	do	2.70	60	15	75
February 15	do	2.70	69	15	84
February 17	do	2.60	49	40	89
March 12	do	6.60	4,940	74	5,010
March 13	do	5.90	3,360	74	3,430
March 13	do	5.40	2,530	74	2,600
March 14	do	4.40	1,210	74	1,280
March 17	do	5.28	2,190	78	2,270
March 17	do	5.15	2,140	78	2,220
March 18	do	4.70	1,440	78	1,520
March 21	do	4.00	666	72	738
March 21	do	4.00	688	72	760
March 30	do	5.10	1,380	76	1,460
April 4	do	4.50	757	76	833
April 18	do	3.80	394	76	470
April 18	do	3.80	436	76	512
May 11	do	3.30	209	76	285
May 11	do	3.30	212	76	288
June 1	do	3.55	292	54	346
June 1	do	3.55	273	54	327
June 29	C. H. Lee	2.90	157	76	233
July 30	W. B. Clapp	2.20	25	76	101
December 28	W. B. Clapp and R. S. Hawley	5.20	1,500	76	1,580

Daily gage height, in feet, of San Gabriel River near Azusa, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Dec.
1				4.8	3.4	3.6	2.8	2.1	
2				4.7	3.4	3.6	2.8	2.0	
3				4.7	3.4	3.5	2.8	1.9	
4			2.6	4.5	3.4	3.5	2.75	1.9	
5			2.7	4.7	3.45	3.4	2.75	1.85	
6				4.4	3.45	3.4	2.7	1.8	
7				4.2	3.4	3.4	2.75	1.7	
8				4.2	3.4	3.3	2.7	1.7	
9				4.2	3.4	3.3	2.7	1.65	
10				4.2	3.4	3.2	2.7	1.6	
11				4.2	3.4	3.2	2.6	1.6	
12			7.9	4.1	3.3	3.2	2.6	1.55	4.0
13		2.7	7.2	4.0	3.3	3.1	2.6	1.5	3.8
14		2.7	4.35	4.0	3.3	3.1	2.6	1.4	3.5
15		2.7	4.5	4.0	3.3	3.1	2.6	1.3	3.0
16		2.7	4.8	3.9	3.3	3.05	2.6		2.3
17		2.6	5.2	3.8	3.3	3.0	2.55		2.1
18		2.1	4.8	3.8	3.2	3.0	2.55		2.1
19	3.9	2.0	4.8	3.8	4.2	3.0	2.55		2.1
20	2.9	2.0	4.6	3.8	3.2	3.0	2.55		1.8
21	2.7	1.9	4.3	3.7	3.2	2.95	2.55		
22	2.3	2.3	4.1	3.6	3.2	2.95	2.5		
23	2.0	2.0	4.1	3.6	3.2	2.9	2.5		
24	1.75	1.9	5.15	3.6	3.1	2.9	2.4		
25	1.6	1.9	7.55	3.6	3.1	3.0	2.4		
26		1.8	8.45	3.5	3.4	2.9	2.35		
27			7.45	3.5	3.3	2.95	2.35		2.0
28			6.7	3.7	4.8	2.95	2.3		5.2
29			6.65	3.5	4.1	2.9	2.25		3.8
30			5.1	3.4	3.75	2.85	2.2		3.5
31			5.1		3.7		2.15		3.2

Note.—The river was dry January 1 to 18, January 26 to February 12, February 27 to March 3, March to 11, August 16 to December 11, and December 21 to 26.

Daily discharge in second-feet of San Gabriel Canals near Azusa, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	37	50	75	78	76	54	76	76	54	42	38	45
2	37	50	68	52	76	52	76	76	55	42	38	46
3	37	49	65	58	76	54	76	76	53	42	38	58
4	37	50	20	76	76	65	76	76	52	42	38	64
5	37	63	20	74	76	76	76	76	52	41	38	51
6	37	63	74	76	76	76	76	76	50	40	39	51
7	37	56	70	78	76	76	76	76	50	40	39	47
8	37	47	70	78	76	76	76	76	49	40	39	47
9	37	47	71	77	76	76	76	76	49	40	38	50
10	36	57	64	76	76	76	76	76	49	40	38	76
11	36	72	56	65	76	76	76	76	49	40	38	60
12	37	69	74	74	76	76	76	76	49	40	38	75
13	37	15	74	78	76	76	76	76	50	40	38	76
14	49	15	74	76	76	76	76	76	50	39	38	76
15	52	15	77	76	76	76	76	76	52	38	38	76
16	41	15	78	76	76	76	76	76	51	38	38	76
17	41	40	78	72	76	76	76	76	50	39	38	76
18	42	74	78	76	76	76	76	72	46	39	37	76
19	0	74	77	76	76	76	76	68	45	40	37	76
20	76	74	75	76	76	76	76	68	45	41	38	72
21	76	75	72	76	76	76	76	68	44	40	41	65
22	76	74	71	76	76	76	76	68	44	40	45	62
23	76	74	65	76	76	76	76	68	43	40	47	59
24	76	74	78	76	76	76	76	66	43	40	45	58
25	66	70	76	76	76	76	76	64	43	40	45	58
26	66	70	78	76	76	76	76	60	43	40	46	76
27	61	73	78	76	76	76	76	60	43	39	46	76
28	57	76	78	76	76	76	76	59	43	38	45	76
29	58	......	76	76	53	76	76	59	42	38	45	76
30	54	......	76	76	48	76	76	58	42	38	45	76
31	52	......	78	......	60	......	76	57	......	38	......	76

Monthly discharge of San Gabriel River near Azusa, Cal., for 1906.

[Drainage area, 222 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	441	36	68.1	4,190	0.307	0.35
February	92	47	68.1	3,780	.307	.32
March	9,430	56	2,160	133,000	9.73	11.22
April	1,110	321	578	34,400	2.60	2.90
May	1,110	251	342	21,000	1.54	1.78
June	364	204	262	15,600	1.18	1.32
July	295	97	155	9,530	.698	.80
August	93	57	72.8	4,480	.328	.38
September	55	42	47.7	2,840	.215	.24
October	42	38	39.8	2,450	.179	.21
November	47	37	40.4	2,400	.182	.20
December	1,600	45	188	11,600	.847	.98
The year	9,430	36	335	245,000	1.51	20.70

NOTE.—These discharges include the water in the canals. The discharge of the river has been obtained from rating tables covering short periods of time, on account of the constant change in channel. Values are fair.

LOS ANGELES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Los Angeles River is formed by Tujunga, Pacoima, and other small creeks which have their source in the Sierra Madre Range of mountains to the northeast of the city of Los Angeles. These streams leave the mountains at a point about 25 miles above the city and enter the comparatively flat country of the San Fernando Valley, where, except in times of excessive flood, the waters disappear in the sand and gravel washes, to reappear at the lower end of this valley, where a secondary range of hills, extending from east to west, forces them to the surface to form what is known as Los Angeles River. Below this point the river discharges through the flat country of the Los Angeles Valley, finally entering the Pacific Ocean near the town of Long Beach, Cal. During the summer months the entire flow of Los Angeles River is diverted at a point about 5 miles above Los Angeles for the supply of the city, only a small amount of water passing this point except during flood discharges. The topography is rough in the upper reaches of this drainage basin, the streams flowing in deep, narrow canyons. In this portion of the basin the formation is of granite, with good soil covering and light timber and heavy brush growth. There is a considerable area of foothill country within this basin, lying between the base of the Sierra Madre Range and the Los Angeles Valley, which has a light covering of brush and grass. The soil of the San Fernando Valley consists, principally, of river wash, coarse sand, and gravel, except along the base of the mountains and foothills, where the soil is of good depth and is under a high state of cultivation. The soil of the Los Angeles Valley, below the city of Los Angeles, consists of a light sandy loam and is under a high state of cultivation. The mean precipitation throughout the basin is from 15 to 30 inches and falls in the form of rain, except on small areas on the higher mountain elevations.

MISCELLANEOUS MEASUREMENTS IN LOS ANGELES RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in Los Angeles River drainage basin during 1906:

Arroyo Seco near Pasadena, Cal.—This stream is a tributary of Los Angeles River. The following measurements were made on this stream during 1906:

April 18, at mouth of canyon, 5 miles above Pasadena, Cal.: Width, 16.5 feet; area, 11.6 square feet; discharge, 20 second-feet.

April 18, at Devils Gate, 3 miles above Pasadena, Cal.: Width, 11 feet; area, 5.9 square feet; discharge, 9.2 second-feet.

April 18, at submerged dam of Pasadena Land and Water Company at Pasadena, Cal.: Discharge, 0.0 second-feet.

Los Angeles River at Seventh Street Bridge, Los Angeles, Cal.—The following measurements were made on Los Angeles River:

March 13, a. m.: Width, 80 feet; area, 166 square feet; discharge, 850 second-feet.
March 13, p. m.: Width, 80 feet; area, 136 square feet; discharge, 555 second-feet.
March 16: Width, 58 feet; area, 43 square feet; discharge, 75 second-feet.
March 17, a. m.: Width, 80 feet; area, 194 square feet; discharge, 1,200 second-feet.
March 17, p. m.: Width, 73 feet; area, 103 square feet; discharge, 420 second-feet.

Diversions from Los Angeles River.—During the summer of 1906 measurements were made to determine the amount of water diverted by the city of Los Angeles for domestic supply, this being ascertained by measurements made in the 44-inch conduit and in the main-supply conduit. The supply is taken from the river near Burbank and includes both surface and underground diversions and constitutes the entire flow of the river at this point during the summer months. Some return seepage water again appears in the river channel near Huron street, Los Angeles, near which point the city has an underground gallery or tunnel for collecting an auxiliary supply which is pumped to the reservoir and used in the general distributing system. The following measurements were made of these diversions during 1906:

Measurements of flow, in second-feet, of diversions from Los Angeles River by the city of Los Angeles in 1906.

Date.	44-inch conduit discharge.	Main-supply conduit discharge.	Total.
February 24	26.59	6.58	33.17
April 20	36.23	7.67	43.90
June 23	31.76	15.86	47.62
July 17	34.73	9.43	44.16
July 20	33.95	10.23	44.18
August 22	30.49	13.67	44.16
August 31	32.86	11.30	44.16
September 21	38.11	4.43	42.54
September 23	29.48	13.20	42.68
November 22	32.73	13.50	46.23
December 18	33.61	15.66	49.27

NOTE.—On February 24, 23.9 second-feet was passing intake and is not included in above total. On April 20, 7.4 second-feet was passing intake and is not included in above total.

MALIBU CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Malibu Creek rises in the Santa Monica Mountains and enters the Pacific Ocean about 15 miles above the town of Santa Monica. This stream is formed by Triunfo and Las Virgenes creeks, which drain the northern portion of the Santa Monica Range and the lower foothill country to the north. The formation throughout this basin is shale, sandstone, and conglomerate, with good soil covering. There is a sparse growth of timber on the higher elevations, but the greater portion of this area has a covering of brush and grass and is used extensively for pasturage, with limited areas of cultivated land for the raising of grain. A reservoir has been constructed on the upper reaches of the Triunfo Creek and the waters are used for irrigation within the basin during the summer months. This reservoir covers an area of about 300 acres when filled. The mean precipitation is about 25 inches and falls wholly in the form of rain.

MALIBU CREEK NEAR CALABASAS, CAL.

This station was established November 29, 1901, by S. G. Bennett. It is located at Chapman's ranch, 40 miles from Los Angeles by wagon road and 8 miles southwest of Calabasas, about one-fourth mile below the mouth of Las Virgenes Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 111, where are given also references to publications that contain data for previous years.

Discharge measurements of Malibu Creek near Calabasas, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 11	C. H. Lee	6	1.2	0.85	1.0
March 12	do	33	45	2.30	122
March 25 [a]	do		94	2.80	406
April 18	do	20	11.1	1.30	19
May 24	do	16	6.4	1.00	7.1

[a] Measured by floats.

Daily gage height, in feet, of Malibu Creek near Calabasas, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.6	0.6	1.0	1.85	1.1	1.0	1.0	0.9	0.9	0.9	[a] 0.9	0.9
2	.6	.6	1.0	1.8	1.1	1.0	1.0	.9	.9	.9	[a] .9	.9
3	.6	.6	1.0	1.7	1.1	1.0	1.0	.9	.9	.9	[a] .9	.9
4	.6	.7	0.8	1.6	1.1	1.0	1.0	.9	.9	.9	[a] .9	.9
5	.6	.7	.8	1.5	1.1	1.0	.95	.9	.9	.9	[a] .9	.9
6	.6	.7	.8	1.4	1.1	1.0	.9	.9	.9	.9	[a] .9	.9
7	.6	.7	.7	1.35	1.1	1.0	.9	.9	.9	.9	[a] .9	.9
8	.6	.7	.7	1.4	1.1	1.0	.9	.9	.9	.9	[a] .9	.9
9	.6	.7	.8	1.4	1.1	1.0	.9	.9	[a] .9	.9	[a] .9	.9
10	.6	.7	.8	1.4	1.05	1.0	.9	.9	[a] .9	.9	[a] .9	1.0
11	.6	.6	.9	[a] 1.4	1.05	1.0	.9	.9	[a] .9	.9	.9	1.05
12	.6	.6	2.55	1.4	1.05	1.0	.9	.9	[a] .9	.9	.9	1.4
13	.6	.6	2.2	1.25	1.05	1.0	.9	.9	[a] .9	.9	.9	1.0
14	.7	1.1	1.55	1.25	1.05	1.0	.9	.9	[a] .9	.9	.9	1.0
15	.7	1.25	1.2	1.2	1.05	1.0	.9	.9	[a] .9	.9	.9	0.9
16	.7	.7	2.6	1.2	1.05	1.0	.9	.9	[a] .85	.9	.9	.85
17	.7	.7	2.1	1.2	1.0	1.0	.9	.9	[a] .85	.9	.9	.85
18	.7	.7	[a] 1.8	1.3	1.0	1.0	.9	.9	[a] .85	.9	.9	.8
19	.7	.7	[a] 1.6	1.3	1.0	1.0	.9	.9	[a] .85	.9	.9	.8
20	.7	.7	1.45	1.3	1.0	1.0	.9	.9	[a] .85	.9	.9	.8
21	1.0	.7	1.68	1.3	1.0	1.0	.9	.9	[a] .85	.9	.9	.8
22	1.0	.7	1.55	1.05	1.0	1.0	.9	.9	.8	.9	.9	.8
23	1.0	.7	1.5	1.05	1.0	1.0	.9	.9	[a] .8	.9	.9	.8
24	1.0	.7	3.4	1.05	[a] 1.0	1.0	.9	.9	[a] .8	.9	.9	.8
25	1.0	1.0	2.92	1.05	[a] 1.1	1.0	.9	.9	[a] .8	.9	.9	.8
26	1.0	1.0	5.55	1.05	1.1	1.0	.9	.9	[a] .8	[a] .9	.9	.85
27	1.0	1.0	3.35	1.1	1.2	1.0	.9	.9	[a] .85	[a] .9	.9	1.85
28	0.6	1.0	2.9	1.1	1.2	1.0	.9	.9	[a] .85	[a] .9	.9	2.6
29	.6		2.1	1.1	1.1	1.0	.9	.9	[a] .85	[a] .9	.9	1.45
30	.6		1.98	1.1	1.0	1.0	.9	.9	[a] .85	[a] .9	.9	1.2
31	.6		1.9		1.0		.9	.9		[a] .9		2.2

[a] Estimated.

Monthly discharge of Malibu Creek near Calabasas, Cal., for 1906.

[Drainage area, 97 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	3	0.8	1.3	80	0.013	0.01
February	12	.8	1.8	100	.019	.02
March	2,600	.9	223	13,700	2.30	2.65
April	62	9	22.1	1,320	.228	.25
May	15	7	9.1	560	.094	.11
June	7	7	7.1	422	.073	.08
July	7	4	4.8	295	.049	.06
August	4.4	4.4	4.4	271	.045	.05
September	4.4	2	3.6	214	.037	.04
October	4.4	4.4	4.4	271	.045	.05
November	4.4	4.4	4.4	262	.045	.05
December	275	2	19.8	1,220	.204	.24
The year	2,600	.8	25.5	18,700	.261	3.61

NOTE.—Discharges were obtained by the indirect method for shifting channels. Owing to the small number of measurements and the shifting conditions, these values are only roughly approximate.

TRIUNFO CREEK, NEAR CALABASAS, CAL.

This station is located 8 miles southwest of Calabasas, Cal., about one-half mile above the mouth of Las Virgenes Creek. The conditions and the bench marks are described in Water-Supply Paper No. 177, page 113, where are given also references to publications that contain data for previous years.

Discharge measurements on Triunfo Creek near Calabasas, Cal., by C. H. Lee, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 11	5.5	1.16	1.25	0.8	March 25	114	100	3.00	399
March 11	6.0	1.5	1.38	1.8	March 26[a]		318	4.50	2,320
March 12	34	29	2.25	98	April 18	22	10.5	2.00	19
March 25	120	114	2.95	459	May 24	11	5	2.05	6.1
March 25	64	81	2.79	313					

[a] Measured by floats.

Monthly discharge of Triunfo Creek near Calabasas, Cal., for 1906.

[Drainage area, 72 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft per sq. mile.	Depth in inches.
January	0.7	0	0.2	12	0.0028	0.003
February	10	0	1.1	61	.015	.02
March	2,000	6	155	9,530	2.15	2.48
April	55	8	19.3	1,150	.268	.30
May	12	5	6.9	424	.096	.11
June	6	6	6.0	357	.083	.09
July	6	3	3.6	221	.050	.06
August	3	0	1.7	105	.024	.03
September	0	0	0.0	0	.00	.00
October	0	0	0.0	0	.00	.00
November	4	0	1.5	89	.021	.02
December	100	2	10.8	664	.150	.17
The year	2,000	0	17.2	11,600	0.238	3.28

NOTE.—The above values are based on very meager data and are only approximate.

VENTURA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Ventura River rises in the Santa Ynez Mountains (a portion of the Coast Range), in Ventura County. It flows in a southerly direction, discharging its waters into the Pacific Ocean at Ventura, Cal. Above the Ojai Valley this stream is known as Matilija Creek. The drainage basin is not large, but heavy floods of short duration are of frequent occurrence during the winter months. Owing to the heavy grade of the stream and the rough and broken character of the topography throughout the basin, its flood waters quickly reach the ocean. Its principal tributaries other than Matilija Creek are San Antonio Creek, which drains a considerable mountain area to the east of Matilija Creek, and Coyote Creek with a small drainage area at a lower elevation to the west. Water is diverted from the main river and its tributaries during the summer months for irrigation and domestic supply in the Ojai Valley and at Ventura.

MISCELLANEOUS MEASUREMENTS IN VENTURA RIVER DRAINAGE BASIN.

The following is a list of miscellaneous discharge measurements made in the Ventura River drainage basin during 1906:

Matilija Creek near Matilija, Cal.—This stream is the principal tributary of the Ventura River. A measurement was made October 24 at the road crossing below Matilija Hot Springs Hotel and above junction of North Fork:

Width, 7 feet; area, 4 square feet; discharge, 7.7 second-feet.

North Fork Matilija Creek near Matilija, Cal.—This stream is a tributary of Matilija Creek. A measurement was made October 24 at point 500 feet above its junction with Matilija Creek and above the flume diversion:

Width, 5 feet; area, 1.9 square feet; discharge, 2.2 second-feet.

San Antonio Creek near Nordhoff, Cal.—This stream is one of the principal tributaries of Ventura River. A measurement was made October 24 near the crossing of the Nordhoff-Ventura road, 1½ miles below Nordhoff and above the canal diversion:

Width, 8 feet; area, 3.8 square feet; discharge, 4.4 second-feet.

SANTA YNEZ RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Santa Ynez River rises in the mountains of Santa Barbara and Ventura counties and flows westerly with a flat grade to the Pacific Ocean, having a length of approximately 75 miles. The Santa Ynez Range of mountains, varying in elevation from 3,000 to 4,000 feet, forms the southern boundary of this drainage basin. The northern divide ranges from 4,500 to 5,500 feet in elevation, culminating in Mount Pinos, the elevation of which is 8,826 feet. The northern part of the watershed is drained by streams running in a southerly direction and uniting with Santa Ynez River proper, which runs close to the northerly base of the Santa Ynez Mountains, flowing westerly and paralleling the Coast Range. The principal tributary, Mono Creek, enters from the north. There are several reservoir sites on Santa Ynez and its tributaries which have been surveyed.

The formation throughout the entire drainage basin consists chiefly of shale and sandstone, the strike being parallel to the coast and the dip nearly vertical, inclining somewhat to the south. The greater portion of the drainage is sparsely covered with brush and small trees, only a small area on the higher elevations having any considerable growth of timber. The mean annual precipitation is estimated at 25 inches for the entire area and falls almost entirely in the form of rain.

SANTA YNEZ RIVER NEAR SANTA BARBARA, CAL.

This station was established November 1, 1903. It is located at the Gibraltar dam site, 5 miles below the original station, and is below the mouth of Mono Creek. It is 9 miles above the San Marcus ranch and halfway between the old quicksilver mines. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, p. 117, where are given also references to publications that contain data for previous years.

Discharge measurements of Santa Ynez River near Santa Barbara, Cal., by L. M. Hyde, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq ft.*	*Feet.*	*Sec.-ft.*
January 12	16	9.0	2.10	4.7	March 17[a]	72	216	4.30	970
January 26	20	7.7	2.18	10.1	March 17[a]	72	201	4.10	780
February 7	18	10.0	2.21	10.1	March 17[a]	72	216	4.30	968
February 10	18	18.3	2.40	37	March 17[a]	72	201	4.10	777
February 11	42	38	2.61	63	March 18[a]	72	172	3.74	544
February 15	75	80	2.94	144	March 18[a]	72	172	3.74	534
February 16	46	38	2.53	59	April 17[a]	62	77	2.80	131
February 24	20	18	2.30	24	June 1	32	39	2.50	65
March 14	82	114	3.37	291	June 29	25	25	2.21	22
March 15	48	72	3.10	189	July 9	13.3	11.7	2.10	8.5
March 16[a]	80	296	5.30	2,440	July 27	7	3.2	1.95	2.0
March 16[a]	80	414	6.70	4,170	August 17	6.2	1.7	1.82	1.0
March 16[a]	80	503	7.65	5,440	September 24	6.5	1.7	1.82	0.7
March 16[a]	85	605	8.65	6,700	December 27	74	150	3.90	468

[a] Measured by floats.

Daily gage height, in feet, of Santa Ynez River near Santa Barbara, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.15	2.25	3.6	2.55	2.5	2.2	1.95	1.8	1.8	1.8	1.9
2	2.0	2.1	2.25	3.55	2.5	2.5	2.2	1.95	1.8	1.8	1.8	1.9
3	2.05	2.1	2.25	3.5	2.5	2.45	2.2	1.9	1.8	1.8	1.8	1.9
4	2.05	2.1	2.8	3.4	2.5	2.45	2.15	1.9	1.8	1.8	1.8	1.9
5	2.05	2.1	2.5	3.3	2.5	2.4	2.15	1.9	1.8	1.8	1.8	1.9
6	2.05	2.2	2.4	3.3	2.45	2.4	2.15	1.9	1.8	1.8	1.8	1.9
7	2.05	2.2	2.35	3.2	2.45	2.4	2.1	1.9	1.8	1.8	1.85	1.9
8	2.05	2.2	2.3	3.1	2.45	2.35	2.1	1.9	1.8	1.8	1.85	1.9
9	2.05	2.15	2.3	3.1	2.45	2.35	2.1	1.9	1.8	1.8	1.85	1.95
10	2.05	2.3	2.3	3.05	2.45	2.35	2.1	1.85	1.8	1.8	1.85	2.1
11	2.05	2.6	2.3	3.05	2.4	2.3	2.1	1.85	1.8	1.8	1.85	2.25
12	2.1	2.4	6.4	3.0	2.4	2.3	2.1	1.85	1.8	1.8	1.85	3.85
13	2.15	2.2	6.0	3.0	2.4	2.3	2.1	1.85	1.8	1.8	1.85	2.5
14	2.25	2.4	3.7	2.9	2.4	2.3	2.1	1.85	1.8	1.8	1.85	2.4
15	2.25	3.05	3.05	2.8	2.4	2.3	2.1	1.85	1.8	1.8	1.85	2.3
16	2.25	2.5	7.2	2.8	2.4	2.3	2.1	1.8	1.8	1.8	1.85	2.2
17	2.25	2.4	4.2	2.8	2.4	2.25	2.1	1.8	1.8	1.8	1.85	2.2
18	2.25	2.35	3.65	2.75	2.35	2.25	2.1	1.8	1.8	1.8	1.85	2.15
19	2.8	2.3	3.35	2.75	2.35	2.25	2.1	1.8	1.8	1.8	1.85	2.1
20	2.5	2.3	3.15	2.7	2.35	2.25	2.05	1.8	1.8	1.8	1.85	2.1
21	2.35	2.4	3.1	2.7	2.35	2.25	2.05	1.8	1.8	1.8	1.85	2.1
22	2.3	2.4	3.0	2.7	2.35	2.25	2.05	1.8	1.8	1.8	1.85	2.05
23	2.3	2.3	3.85	2.7	2.35	2.25	2.0	1.8	1.8	1.8	1.85	2.05
24	2.25	2.3	6.6	2.7	2.35	2.25	2.0	1.8	1.8	1.8	1.85	2.05
25	2.25	2.3	6.75	2.65	2.35	2.25	2.0	1.8	1.8	1.8	1.85	2.05
26	2.2	2.3	7.1	2.65	2.5	2.2	2.0	1.8	1.8	1.8	1.85	2.6
27	2.15	2.25	4.9	2.6	3.15	2.2	2.0	1.8	1.8	1.8	1.85	3.35
28	2.15	2.25	4.4	2.6	3.9	2.2	1.95	1.8	1.8	1.8	1.85	2.8
29	2.15	......	4.0	2.6	2.9	2.2	1.95	1.8	1.8	1.8	1.95	2.75
30	2.15	......	3.8	2.6	2.7	2.2	1.95	1.8	1.8	1.8	1.9	2.75
31	2.15	......	3.7	......	2.55	......	1.95	1.8	......	1.8	......	3.0

Rating table for Santa Ynez River near Santa Barbara, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	1	2.60	65	3.40	315	4.40	1,065	6.00	3,070
1.90	2	2.70	83	3.50	370	4.60	1,285	6.20	3,360
2.00	3	2.80	104	3.60	420	4.80	1,510	6.40	3,650
2.10	6	2.90	129	3.70	495	5.00	1,750	6.60	3,940
2.20	12	3.00	156	3.80	565	5.20	1,990	6.80	4,230
2.30	22	3.10	186	3.90	635	5.40	2,250	7.00	4,520
2.40	35	3.20	223	4.00	710	5.60	2,510	7.20	4,810
2.50	49	3.30	265	4.20	875	5.80	2,790		

NOTE.—This table is based on discharge measurements made during 1906 and is fairly well defined.

Monthly discharge of Santa Ynez River near Santa Barbara, Cal., for 1906.

[Drainage area, 207 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	104	3	14.8	910	0.071	0.08
February	171	6	27.4	1,520	.132	.14
March	4,810	17	1,050	64,600	5.07	5.84
April	430	65	158	9,400	.763	.85
May	635	28	67.4	4,140	.326	.38
June	49	12	23.9	1,420	.115	.13
July	12	2.5	5.7	350	.028	.03
August	2.5	1.0	1.4	86	.0068	.008
September	1	1	1	60	.0048	.005
October	1	1	1	61	.0048	.006
November	2.5	1	1.4	83	.0068	.008
December	600	2	52.1	3,200	.252	.29
The year	4,810	1	117	85,800	.565	7.76

NOTE.—The above values are fair.

MISCELLANEOUS MEASUREMENTS IN SANTA YNEZ RIVER DRAINAGE BASIN.

The following miscellaneous discharge measurements were made in the Santa Ynez River drainage basin during 1905 and 1906:

Santa Ynez River near Lompoc, Cal.—At the old headworks of the Southern Pacific Milling Company's canal (not in use), 2½ miles above Lompoc, Cal.:

1905—September 25: Width, 21 feet; area, 7.7 square feet; discharge, 8.8 second-feet.

1906—April 19: Width, 97 feet; area, 135 square feet; discharge, 358 second-feet.
July 25: Width, 28 feet; area, 15 square feet; discharge, 21 second-feet.
September 25: Width, 14 feet; area, 6.1 square feet; discharge, 7.1 second-feet.

At the wagon bridge, 1½ miles above Lompoc, Cal.:

1906—November 10: Width, 36 feet; area, 12.8 square feet; discharge, 10 second-feet.
December 12: Width, 107 feet; area, 144 square feet; discharge, 259 second-feet.

SANTA MARIA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Santa Maria River drains the northern slope of the San Rafael Mountains and a limited area of foothill country to the north of this range. It flows in a westerly direction, finally discharging its waters into the Pacific Ocean at Guadalupe, about 25 miles south of San Luis Obispo. Its flow is torrential in character, subject to floods of short duration during the rainy period, but being practically dry during the summer months. It has numerous tributaries, the most important of which is the Sisquoc, which enters it about 12 miles above the town of Santa Maria. The gaging station is located about 25 miles above the town of Santa Maria and above most of its important tributaries. The country throughout this basin consists of rolling foothills, with the exception of the higher elevations of the San Rafael Mountains, which reach an elevation of 6,000 to 8,000 feet. The river breaks from the foothills at the point where it is joined by the Sisquoc and flows through the flat country of the Santa Maria Valley for a distance of about 25 miles until it joins the Pacific Ocean at Guadalupe. The formation throughout this basin is of shale, sandstone, and conglomerate, with a good covering of heavy clay soil. There is considerable growth of timber on the higher elevations of the San Rafael Mountains, but over most of the area the growth of timber is light, with large areas of brush and grass. The pasturage of stock is carried on extensively throughout the basin. There are no diversions along this stream for irrigation, although tunnel work has been attempted above Santa Maria for the development of underground water, with poor results. There are numerous wells in the vicinity of Santa Maria which produce considerable water for the irrigation of land in that locality, the soil being very deep and of exceptional quality, susceptible to the highest state of cultivation. The mean precipitation in this drainage basin is probably about 25 inches. The greatest rainfall occurs on the lower elevations near the coast. The higher elevations receive some snowfall, which melts early in the spring and does not tend to keep up the flow of the stream through the summer.

SANTA MARIA RIVER NEAR SANTA MARIA, CAL.

This station was established October 22, 1903, by W. B. Clapp. It is located near the ranch house on Dutard's ranch, 21 miles above Santa Maria, Cal., a station on the Pacific Coast Railway. It is reached by driving from Santa Maria. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 120, where are given also references to publications that contain data for previous years.

Gage heights observed at this station in 1906 are of no value, therefore no discharges can be computed.

Discharge measurements of Santa Maria River near Santa Maria, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 23	R. S. Hawley	28	14.8	0.90	17.9
June 6	do	24	12.8	[a]2.20	11.9
November 7	do	20	7.0	1.70	4.9

[a] Zero of gage lowered 2 feet.

SALINAS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The Arroyo Seco is the most northern tributary of any size of Salinas River and rises on the slopes of the highest portion of the Santa Lucia Range, one of the ranges that go to make up the Coast Range of California, extending in a general southeast direction from San Francisco Bay. The upper valleys of this stream are far back in the range, surrounded by high mountains.

The drainage area of the Arroyo Seco is almost entirely made up of sharp ridges and V-shaped canyons. The western portion is well covered with brush and trees of medium size. Toward the east this growth decreases until at the Salinas Valley the country is bare. The stream beds of this area fall rapidly, the Arroyo Seco rising at an elevation of nearly 6,000 feet and discharging into the Salinas at an elevation of 170 feet.

Below the gaging station several canals divert water from this stream before it reaches the broad wash of sand and gravel on the flat floor of the Salinas Valley, into which it sinks during the dry season and from which it receives its name, "Arroyo Seco."

On the stream and its tributaries five reservoir sites of more or less value for possible storage have already been surveyed.

This portion of the range undoubtedly receives as great rainfall as any other locality in this region; it is estimated that the average annual precipitation is from 30 to 50 inches and falls almost entirely in the form of rain.

ARROYO SECO NEAR SOLEDAD, CAL.

The original gaging station on this stream was established by W. W. Cockins, jr., in December, 1900, at Foster's ranch, near Piney, Cal. High water of January, 1901, enlarged an old side channel, dividing the stream into two channels. The gaging station was then removed to Pettitt's ranch, 4 miles below the old station. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 123, where are given also references to publications that contain data for previous years.

Discharge measurements of Arroyo Seco near Soledad, Cal., by Hawley and Pettitt, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 24	124	181	6.52	396	April 22	122	165	6.15	338
March 6	123	186	6.22	436	April 29	121	154	6.00	282
March 9	123	169	6.30	388	May 5	120	141	5.81	226
March 11	122	157	6.15	328	May 13	120	133	5.72	198
March 13	140	882	11.90	5,700	May 21	119	121	5.60	169
March 13	130	389	8.20	1,530	May 28	124	287	7.40	1.010
March 15	137	562	10.10	3,330	June 4	121	154	6.00	294
March 16	136	466	9.32	2.440	June 5	62	65	5.93	269
March 17	134	405	8.45	1.790	June 24	75	56	5.50	121
March 18	132	349	7.88	1,240	July 4	47	67	5.35	82
March 20	128	285	7.38	856	July 13	40	47	5.25	52
March 23	135	680	11.40	3.930	July 29	34	37	5.13	28
March 24	135	446	8.75	1.900	August 12	31	29	5.05	15.1
March 26	133	475	8.95	2.430	August 26	31	29	5.02	18.2
March 30	129	353	8.10	1.410	September 18	31	28	4.90	13.5
March 31	133	496	9.25	2,510	October 27	18	18.8	5.01	11.2
April 8	124	244	6.95	633	December 31	124	275	7.20	83.8
April 15	122	187	6.35	414					

Daily gage height, in feet, of Arroyo Seco near Soledad, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.55	5.65	6.2	8.3	5.95	6.1	5.4	5.1	4.5	5.0	5.05	5.2
2	5.52	5.6	6.15	8.0	5.9	6.05	5.4	5.1	4.5	5.0	5.05	5.15
3	5.52	5.58	6.6	7.75	5.9	6.0	5.4	5.1	4.7	5.0	5.05	5.15
4	5.53	5.55	8.45	7.55	5.9	6.0	5.35	5.1	4.6	5.0	5.25	5.15
5	5.52	5.52	6.9	7.35	5.8	5.9	5.35	5.1	4.6	5.0	5.5	5.15
6	5.52	5.6	6.65	7.2	5.8	5.9	5.35	5.1	4.6	5.0	5.25	5.15
7	5.52	5.5	6.5	7.0	5.8	5.85	5.3	5.1	4.6	4.9	5.15	5.15
8	5.52	5.49	6.39	6.95	5.75	5.8	5.3	5.1	4.6	4.8	5.15	5.15
9	5.51	5.45	6.3	6.8	5.7	5.8	5.3	5.1	4.5	4.8	5.1	5.3
10	5.51	5.41	6.21	6.7	5.7	5.75	5.3	5.1	4.6	4.8	5.1	5.3
11	5.52	5.7	6.28	6.6	5.8	5.7	5.3	5.05	4.6	4.8	5.1	[a]13.0
12	6.85	5.51	11.3	6.5	5.75	5.7	5.25	5.05	4.6	4.9	5.1	7.95
13	8.18	5.8	8.15	6.5	5.7	5.7	5.25	5.05	4.6	5.0	5.1	7.2
14	7.48	5.92	7.8	6.4	5.7	5.65	5.25	5.05	4.6	5.0	5.1	6.6
15	7.30	7.05	10.1	6.35	5.7	5.65	5.2	5.0	4.7	5.0	5.1	6.2
16	6.75	6.45	9.25	6.3	5.7	5.6	5.2	5.0	4.7	5.0	5.1	6.1
17	7.98	6.3	8.4	6.3	5.65	5.6	5.2	5.0	4.8	5.0	5.1	5.85
18	7.98	6.28	7.88	6.2	5.6	5.6	5.2	5.0	4.9	5.0	5.1	5.8
19	10.12	6.18	7.6	6.2	5.6	5.55	5.2	5.0	4.9	5.0	5.1	5.7
20	8.0	6.1	7.3	6.2	5.6	5.5	5.2	5.0	5.0	5.0	5.1	5.6
21	7.2	6.3	7.95	6.2	5.6	5.5	5.2	5.0	5.0	5.0	5.1	5.55
22	6.8	6.85	7.48	6.2	5.6	5.5	5.2	5.05	5.0	5.05	5.15	5.5
23	6.5	6.6	8.94	6.2	5.6	5.5	5.2	5.05	5.0	5.05	5.15	5.5
24	6.3	6.59	8.85	6.2	5.6	5.5	5.2	5.05	5.0	5.05	5.1	5.5
25	6.15	6.49	8.7	6.2	5.6	5.5	5.2	5.05	5.05	5.05	5.15	5.5
26	6.0	6.39	9.0	6.05	6.55	5.5	5.15	5.0	5.05	5.05	5.15	7.45
27	5.95	6.3	8.35	6.05	8.3	5.5	5.1	5.0	5.05	5.05	5.15	7.2
28	5.9	6.3	8.0	6.0	7.3	5.5	5.1	4.9	5.05	5.05	5.15	6.7
29	5.85	....	7.7	6.0	6.75	5.45	5.15	4.8	5.0	5.05	5.2	6.35
30	5.75	....	8.12	6.0	6.45	5.4	5.1	4.7	5.0	5.05	5.2	6.25
31	5.7	....	9.08	....	6.4	....	5.1	4.6	....	5.05	....	7.2

[a] Estimated.

Rating table for Arroyo Seco near Soledad, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.50	0	5.60	153	6.70	553	7.80	1,195	9.80	2,980
4.60	1	5.70	185	6.80	599	7.90	1,265	10.00	3,180
4.70	3	5.80	218	6.90	648	8.00	1,340	10.20	3,380
4.80	5	5.90	252	7.00	700	8.20	1,495	10.40	3,580
4.90	8	6.00	286	7.10	754	8.40	1,660	10.60	3,780
5.00	14	6.10	320	7.20	810	8.60	1,840	10.80	3,980
5.10	24	6.20	356	7.30	868	8.80	2,020	11.00	4,180
5.20	40	6.30	393	7.40	928	9.00	2,200	12.00	5,180
5.30	63	6.40	431	7.50	990	9.20	2,390	13.00	6,250
5.40	91	6.50	470	7.60	1,055	9.40	2,580		
5.50	121	6.60	510	7.70	1,125	9.60	2,780		

NOTE.—This table is based on 35 discharge measurements made during 1906 and is well defined between gage heights 5 feet and 10 feet.

Monthly discharge of Arroyo Seco near Soledad, Cal., for 1906.

[Drainage area, 215 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	3,300	124	556	34,200	2.59	2.99
February	727	94	302	16,800	1.41	1.47
March	4,480	338	1,300	83,600	6.32	7.29
April	1,580	286	558	33,200	2.60	2.90
May	1,580	153	297	18,300	1.38	1.59
June	320	91	178	10,600	.828	.92
July	91	24	50.8	3,120	.236	.27
August	24	1	17.3	1,060	.080	.09
September	19	0	7.1	422	.033	.04
October	19	5	14.1	867	.066	.08
November	121	19	31.8	1,890	.148	.16
December	6,250	32	492	30,300	2.29	2.64
The year	6,250	0	322	234,000	1.49	20.44

NOTE.—Values are rated as follows: January to June, excellent; July and December, good; August to November, fair.

SAN FRANCISCO BAY DRAINAGE BASIN.

GENERAL FEATURES.

Sacramento River, rising in northern California and flowing south, and San Joaquin River, rising in the southern Sierras and flowing north, drain the western slope of the Sierra Nevada and the eastern slope of the Coast Range north of San Francisco. They meet near Suisun Bay, finally discharging their waters into the Pacific Ocean through San Francisco Bay.

SACRAMENTO RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Sacramento River is the principal river of California, and drains all of the territory south of Mount Shasta and between the Coast Range and Trinity Range on the west and the Sierra Nevada on the east. The portion of the drainage basin above Red Bluff, Cal., extends from the Trinity Mountains on the west to Warner Mountains near the California-Nevada State line on the east. The watershed on the west from the Trinity Mountains is comparatively narrow, being only from 10 to 35 miles in width, and furnishes a very small proportion of the discharge of this river, but from the east Pit River, which is the most important tributary, drains a large area extending about 120 miles east from Sacramento River between Mount Shasta on the north and Lassen Peak on the south. The greater portion of this basin is composed of lava and shows other evidences of volcanic activity, such as volcanic cones and craters. Nearly all the streams tributary to Pit River have their origin in large springs, many of which discharge several hundred second-feet. The most important tributary of the Pit is McCloud River, draining the southeastern slope of Mount Shasta. It derives its waters principally from the melting of the snow on the high elevations of this mountain. The western portion of the watershed extending along the Trinity Range is well timbered, as is also that portion of the drainage area in the Sierra Nevada lying between Mount Shasta and Lassen Peak. Farther east, however, there is little or no forest covering, and the country is used extensively for pasturage. The rainfall is very unequally distributed, varying from less than 10 inches in the eastern portion of the basin to 50 inches along the northern and western portion. Below the gaging station the river enters the Sacramento Valley, through which it flows on a comparatively light grade until it reaches Suisun Bay. During the winter months, when the Sacramento and its tributaries are in flood, large areas of the Sacramento Valley are overflowed. The floods that occur in the latter part of the rainy season, after the large overflow areas or basins are filled, cause great damage in the lower portion of the valley.

MAIN SACRAMENTO RIVER.

SACRAMENTO RIVER NEAR RED BLUFF, CAL.

The gaging station at Jellys Ferry, which is located about 12 miles above the town of Red Bluff, was established April 30, 1895. The right bank of the river is high, but the left bank is liable to overflow when the river rises above the 25-foot mark. The river has been known to reach the 35-foot mark. Because of the liability to overflow it was deemed advisable to select a new gaging station, where the water at flood stage could be more confined. A point in Iron Canyon, where the river had been gaged by the State engineering department in 1879 and by commissioner of public works in 1893–94, was chosen as a new gaging station. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, p. 128, where are given also references to publications that contain data for previous years.

Discharge measurements of Sacramento River near Red Bluff, Cal., by R. S. Hawley, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 27	550	8,230	10.30	41,600	May 16	529	5,290	4.64	15,700
February 27	546	7,850	9.45	36,000	May 18	527	4,980	4.14	13,800
March 13	550	7,920	9.60	38,200	June 12	534	6,270	6.50	23,100
March 14	550	7,780	9.30	36,900	June 13	532	5,850	5.68	19,000
March 26[a]	590	12,100	18.30	92,900	July 7	520	4,300	2.90	9,100
April 11	536	6,550	7.00	24,500	September 6	496	3,330	1.63	5,470
May 3	531	5,570	5.25	18,500	December 11	538	6,570	7.60	26,900

[a] Measured by floats.

Daily gage height, in feet, of Sacramento River near Red Bluff, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	2.9	7.65	15.5	5.5	5.6	3.3	1.9	1.7	1.6	1.6	1.7
2	1.4	2.8	6.95	12.55	5.4	5.5	3.25	1.9	1.65	1.6	1.6	1.7
3	1.4	2.7	10.65	10.75	5.3	5.5	3.2	1.9	1.65	1.6	1.85	1.65
4	1.4	2.7	10.75	9.6	5.2	8.85	3.1	1.9	1.65	1.55	2.4	1.7
5	1.4	2.6	8.2	8.55	5.3	7.75	3.0	1.9	1.65	1.55	3.25	1.7
6	1.45	2.55	7.3	7.9	5.15	7.8	2.95	1.8	1.65	1.55	2.2	1.75
7	1.45	2.5	6.9	7.5	5.0	6.85	2.9	1.8	1.6	1.55	2.0	2.35
8	1.45	2.5	6.6	7.3	4.9	6.2	2.8	1.8	1.6	1.55	1.9	2.35
9	1.5	2.6	6.6	7.25	4.8	6.0	2.8	1.8	1.6	1.55	1.85	2.4
10	1.8	2.7	6.5	7.1	4.9	5.6	2.7	1.75	1.6	1.55	1.8	5.2
11	1.75	3.25	6.45	6.9	4.8	5.35	2.7	1.75	1.6	1.55	1.8	7.75
12	3.3	3.9	14.85	6.55	4.7	6.35	2.6	1.75	1.6	1.55	1.75	7.3
13	4.65	....	9.9	6.2	4.55	5.6	2.6	1.7	1.6	1.55	1.75	5.0
14	4.3	3.35	9.55	6.5	4.55	5.25	2.5	1.7	1.75	1.55	1.75	3.85
15	4.35	10.95	7.75	5.9	4.9	5.0	2.5	1.7	1.7	1.6	1.8	3.15
16	12.8	7.45	7.0	5.8	4.6	5.9	2.4	1.7	1.7	1.6	1.8	3.0
17	9.85	7.3	6.6	5.8	4.3	5.4	2.4	1.7	1.65	1.6	1.8	2.85
18	12.7	6.75	5.95	5.75	4.2	5.0	2.4	1.65	1.65	1.6	1.75	2.8
19	22.6	10.6	5.35	5.6	4.1	4.05	2.3	1.7	1.6	1.6	1.7	2.6
20	9.1	8.5	5.85	5.6	4.0	4.5	2.3	1.7	1.6	1.6	1.7	2.4
21	5.8	9.9	8.3	5.7	4.0	4.3	2.25	1.7	1.6	1.55	1.7	2.4
22	4.7	10.0	12.95	5.75	3.9	4.1	2.2	1.75	1.6	1.6	1.7	2.3
23	4.3	12.75	10.7	6.0	3.8	3.95	2.2	1.75	1.65	1.6	1.7	2.3
24	4.0	11.5	14.85	5.8	3.7	3.75	2.1	1.7	1.7	1.6	1.7	2.65
25	3.75	10.35	16.6	6.1	4.4	3.7	2.1	1.7	1.7	1.6	1.7	4.8
26	3.55	8.4	17.95	5.5	9.6	3.6	2.1	1.7	1.6	1.6	1.7	12.7
27	3.4	9.1	15.45	6.0	11.0	3.75	2.0	1.7	1.6	1.6	1.7	13.65
28	3.4	8.5	12.6	6.2	10.6	3.7	2.0	1.7	1.6	1.6	1.65	8.55
29	3.25	....	10.8	5.6	8.95	3.5	2.0	1.7	1.6	1.6	1.7	6.5
30	3.2	....	12.85	5.55	7.35	3.35	2.0	1.7	1.6	1.6	1.7	5.3
31	3.05	....	23.35	....	6.5	....	1.9	1.7	....	1.6	....	6.0

Rating table for Sacramento River near Red Bluff, Cal., for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	5,410	2.60	8,810	3.80	12,720	6.00	21,100	14.00	61,700
1.50	5,650	2.70	9,120	3.90	13,000	6.20	21,940	15.00	68,200
1.60	5,920	2.80	9,430	4.00	13,400	6.40	22,780	16.00	75,100
1.70	6,190	2.90	9,740	4.20	14,120	6.60	23,620	17.00	82,200
1.80	6,460	3.00	10,050	4.40	14,840	6.80	24,460	18.00	89,700
1.90	6,730	3.10	10,380	4.60	15,580	7.00	25,300	19.00	97,600
2.00	7,000	3.20	10,710	4.80	16,340	8.00	29,700	20.00	105,900
2.10	7,300	3.30	11,040	5.00	17,100	9.00	34,300	21.00	114,600
2.20	7,600	3.40	11,370	5.20	17,900	10.00	39,100	22.00	123,700
2.30	7,900	3.50	11,700	5.40	18,700	11.00	44,200	23.00	133,200
2.40	8,200	3.60	12,040	5.60	19,500	12.00	49,700	24.00	143,100
2.50	8,500	3.70	12,380	5.80	20,300	13.00	55,600		

NOTE.—This table is based on discharge measurements made during 1902-1906 and is well defined.

Monthly discharge of Sacramento River near Red Bluff, Cal., for 1906.

[Drainage area, 9,300 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	129,000	5,410	14,700	904,000	1.58	1.82
February	54,100	8,500	23,200	1,290,000	2.49	2.59
March	137,000	18,500	42,500	2,610,000	4.57	5.27
April	71,600	19,100	26,300	1,560,000	2.83	3.16
May	44,200	12,400	19,400	1,190,000	2.09	2.41
June	33,600	11,200	18,100	1,080,000	1.95	2.18
July	11,000	6,730	8,530	524,000	.917	1.06
August	6,730	6,060	6,330	389,000	.681	.79
September	6,320	5,920	6,020	358,000	.647	.72
October	5,920	5,780	5,870	361,000	.631	.73
November	10,900	5,920	6,570	391,000	.706	.79
December	59,500	6,060	15,400	947,000	1.66	1.91
The year	137,000	5,410	16,100	11,600,000	1.73	23.43

NOTE.—These values are excellent.

MISCELLANEOUS MEASUREMENT IN SACRAMENTO RIVER DRAINAGE BASIN.

The following measurement was made of Sacramento River at Baird station, on the Southern Pacific Railway, near Gregory, Cal., October 9, 1906:

Width, 115 feet; area, 300 square feet; discharge, 315 second-feet.

PIT RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Pit River has its source in the Warner Mountains in the extreme northeast part of California. It flows in a southwesterly direction, discharging its waters into Sacramento River a few miles above Redding, Cal. It has numerous tributaries, the larger of which have their source in large springs, which discharge from crevices in the lava formation. About 50 per cent of the area of this drainage basin is barren of timber and composed principally of lava with a light soil covering, being used extensively for pasturage and the raising of stock. There are numerous small valleys with light grades, which hold the water throughout the summer months principally in the state of swamps. These areas are used mainly as meadow land and for the raising of stock feed. Pit River does not discharge in any great volume until it reaches a point near Fall River Mills, which lies about midway between the point where the Pit River enters the Sacramento and its source. Fall River, which is the principal tributary of the Pit from the north, receives its water supply from large perennial springs which discharge 1,500 second-feet. Hat Creek and Burney Creek are also large tributaries from the south and drain the northern slope of Lassen Peak. Their principal sources are also from large perennial springs in the lava formation.

West Valley Creek is a tributary of South Fork of Pit River. Ash Creek flows into Clear Creek, through which it enters Pit River from the south. There is considerable timber scattered throughout this drainage basin, the principal growth lying in the southern portion of the basin and also in that section lying north of Pit River and between Fall River and the upper Sacramento. There are numerous reservoir sites on the upper reaches of this stream, all of which have been or are being surveyed. Several gaging stations are maintained on Pit River and tributaries at points where surveys have been made for the construction of storage reservoirs. The rainfall throughout this basin is very unevenly distributed, ranging from 10 inches in the eastern portion to 50 to 75 inches in the western and northwestern portion. About 50 per cent of the precipitation falls in the form of snow, but does not remain any length of time except on the higher elevation of Mount Shasta and Lassen Peak.

McCloud River drains the southeastern slope of Mount Shasta. Its drainage area is comparatively small, covering 676 square miles. It is long and narrow, extending from north to south. There are few tributaries. Its main water supply comes from Mount Shasta, on which the snow remains during the entire year. It is also fed by numerous large springs scattered throughout the drainage basin. The precipitation is very heavy and is principally in the form of rain, except on the higher elevations of Mount Shasta. The discharge of this stream seldom falls below 1,200 second-feet. It discharges into the Pit River a few miles above the junction of the Pit with the Sacramento. The entire basin is well timbered.

PIT RIVER NEAR BIEBER, CAL.

This station was established January 22, 1904. It is located 12 miles below Bieber, Cal., near Muck Valley. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 136, where are given also references to publications that contain data for previous years.

Discharge measurements of Pit River near Bieber, Cal., by F. H. Holabird, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 29[a]	213	870	5.90	1,820	April 9	224	1,100	6.90	3,350
February 3[a]	209	680	5.00	1,320	April 12	220	986	6.40	2,580
February 5[a]	209	680	5.00	1,180	April 13	219	942	6.20	2,340
February 8[a]	207	615	4.70	938	April 14	219	917	6.10	2,190
February 10[a]	207	615	4.70	877	April 15	214	870	5.90	1,880
February 12	205	637	4.80	983	April 17	217	853	5.80	1,870
February 14	207	723	5.20	1,310	April 19	214	826	5.70	1,780
February 16	220	962	6.30	2,610	April 20	210	807	5.60	1,700
February 17	219	942	6.20	2,430	April 27	207	740	5.32	1,440
February 19	220	987	6.40	2,660	May 5	207	616	4.70	933
February 21	220	1,050	6.70	3,190	May 12	207	616	4.70	906
February 23	224	1,100	6.90	3,530	May 19	207	660	4.90	1,080
February 26	220	942	6.20	2,420	May 26	207	596	4.60	858
February 28	224	1,120	7.04	3,690	June 2	207	573	4.50	773
March 8	215	892	6.00	2,060	June 9	193	512	4.35	657
March 12	224	1,150	7.10	3,640	June 16	193	473	4.10	525
March 13	230	1,270	7.65	4,610	August 11	98	176	2.30	64
March 18	219	942	6.25	2,390	August 25	68	128	1.80	20
March 20	219	942	6.20	2,320	September 1	68	128	1.80	20
March 21	222	985	6.50	2,700	September 8	68	128	1.80	19
March 22	224	1,210	7.52	4,340	September 15	68	132	1.90	27
March 23[b]		1,680	9.50	9,500	September 23	68	137	2.00	29
April 4	224	1,190	7.30	3,130	September 29	68	128	1.85	24
April 5	224	1,100	6.90	3,330	October 7	68	130	1.90	25
April 6	224	1,080	6.85	3,260	October 14	68	141	2.00	29
April 7	224	1,100	6.90	3,280	October 26	98	208	2.60	81
April 8	224	1,100	6.95	3,310					

[a] Measured by Toler and Holabird.

[b] Velocities not measured in entire cross section; discharge probably too great.

Daily gage height, in feet, of Pit River near Bieber, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	....	5.5	6.7	9.1	5.1	4.5	4.1	2.6	1.8	1.85
2	....	5.0	6.5	8.3	5.1	4.5	4.0	2.6	1.8	1.85
3	....	5.0	6.3	7.8	4.9	4.5	4.0	2.6	1.8	1.9
4	....	5.0	6.05	7.3	4.8	4.5	3.8	2.6	1.8	1.9
5	....	5.0	6.1	6.9	4.7	4.5	3.8	2.6	1.8	1.9
6	....	4.8	6.0	6.85	4.7	4.4	3.8	2.6	1.8	1.9
7	....	4.7	6.0	6.9	4.7	4.4	3.8	2.5	1.8	1.9
8	....	4.7	6.0	6.95	4.7	4.4	3.85	2.5	1.8	1.9
9	....	4.7	6.4	6.9	4.7	4.35	3.85	2.4	....	1.9
10	....	4.7	6.8	6.8	4.7	4.3	3.7	2.3	....	2.0
11	....	4.7	7.0	6.5	4.7	4.3	3.7	2.3	....	2.0
12	....	4.8	7.1	6.4	4.7	4.2	3.7	2.3	....	2.0
13	....	5.1	7.6	5.2	4.8	4.2	3.7	2.3	....	2.0
14	....	5.2	7.1	6.1	4.9	4.2	3.5	2.9	....	....
15	3.45	5.8	6.8	6.0	4.9	4.2	3.5	2.9	1.9	....
16	4.35	6.3	6.3	5.9	4.8	4.1	3.5	2.6	1.9	....
17	4.25	6.2	6.1	5.8	4.8	4.1	3.4	2.4	2.0	....
18	4.6	6.2	6.2	5.8	4.8	4.0	3.4	2.2	2.0	....
19	5.8	6.4	6.4	5.7	4.9	4.0	3.35	2.2	2.0	....
20	6.4	6.4	6.2	5.6	4.9	3.5	3.35	....	1.9	....
21	6.4	6.7	6.4	5.5	4.9	3.4	3.3	....	1.9	....
22	6.8	7.2	7.4	5.5	4.8	3.35	....	....	1.9	....
23	7.3	6.9	9.5	5.4	4.65	3.55	....	....	2.0	....
24	7.8	6.7	10.5	5.4	4.65	3.55	....	....	2.0	....
25	6.0	6.5	11.5	5.2	4.6	4.2	....	1.8	2.0	....
26	6.0	6.2	11.0	5.2	4.6	4.2	....	1.8	1.9	....
27	6.1	6.4	10.2	5.3	4.6	4.2	....	1.8	1.9	....
28	6.1	7.0	9.3	5.3	4.6	4.2	....	1.8	1.9	....
29	6.1	....	8.6	5.2	4.6	4.2	....	1.8	1.85	....
30	6.0	....	8.2	5.15	4.6	4.1	....	1.8	1.85	....
31	5.8	....	8.4	....	4.6	....	....	1.8	....	....

Rating table for Pit River near Bieber, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft*
1.80	21	2.90	108	4.00	450	5.00	1,140	7.00	3,520
1.90	24	3.00	120	4.10	500	5.20	1,320	7.20	3,840
2.00	29	3.10	135	4.20	560	5.40	1,500	7.40	4,160
2.10	35	3.20	154	4.30	620	5.60	1,700	7.60	4,480
2.20	41	3.30	177	4.40	685	5.80	1,900	7.80	4,820
2.30	49	3.40	205	4.50	755	6.00	2,120	8.00	5,180
2.40	57	3.50	240	4.60	825	6.20	2,360	9.00	7,140
2.50	66	3.60	276	4.70	900	6.40	2,630	10.00	9,600
2.60	76	3.70	316	4.80	980	6.60	2,920	11.00	12,400
2.70	86	3.80	356	4.90	1,060	6.80	3,220	12.00	15,200
2.80	96	3.00	400						

NOTE.—This table is based on 53 discharge measurements made during 1906 and is well defined below gage height 7.5 feet.

Monthly discharge of Pit River near Bieber, Cal., for 1906.

[Drainage area, 2,950 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January (15-31)	4,820	222	2,150	72,500	0.728	0.46
February	3,840	900	1,930	107,000	.654	.68
March	13,800	2,120	4,640	285,000	1.57	1.81
April	7,300	1,280	2,590	154,000	.878	.98
May	1,230	825	948	58,300	.321	.37
June	755	190	544	32,400	.184	.21
July (1-21)	500	177	311	13,000	.105	.08
August	108	21	[a] 51	3,140	.017	.02
September	29	21	[a] 24	1,430	.008	.009
October (1-13)	29	22	25	645	.008	.004
The period				727,000		

[a] Discharges interpolated for days when gage was not read.

NOTE.—Values are rated as follows: January to June, excellent; July, good; August to October, fair.

M'CLOUD RIVER NEAR GREGORY, CAL.

This station was established March 23, 1902, in cooperation with the McCloud River Electric Company. It is located at Johns Camp, near Hirze Mountain, 14 miles east of Gregory post-office, Cal. Baird Station, on the Southern Pacific Railroad, is just across Sacramento River from Gregory. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 147, where are given also references to publications that contain data for previous years.

Discharge measurements of McCloud River near Gregory, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 16[a]	F. P. Ackerson	143	1,080	6.05	8,780
January 16[a]	do	152	1,330	7.40	12,400
February 12	R. S. Hawley	104	556	1.90	1,580
April 12	do	105	685	3.07	2,910
May 17	do	104	637	2.45	2,360
October 10	do	100	576	1.56	1,340

[a] Measured by floats.

Daily gage height, in feet, of McCloud River near Gregory, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.6	1.85	3.3	5.6	2.85	3.6	2.3	1.8	1.6	1.6	1.55	1.55
2	1.6	1.85	3.3	4.6	2.8	3.6	2.25	1.8	1.6	1.6	1.6	1.55
3	1.55	1.85	3.55	4.15	2.8	4.65	2.25	1.8	1.6	1.6	1.7	1.55
4	1.55	1.8	3.3	3.75	2.8	6.5	2.2	1.8	1.6	1.6	2.35	1.55
5	1.55	1.8	3.0	3.5	2.75	5.65	2.2	1.8	1.6	1.6	1.75	1.5
6	1.55	1.8	2.75	3.4	2.7	5.35	2.15	1.8	1.6	1.6	1.6	1.5
7	1.55	1.75	2.8	3.3	2.7	4.6	2.2	1.8	1.6	1.6	1.6	1.5
8	1.55	1.75	2.85	3.3	2.7	4.1	2.15	1.8	1.6	1.6	1.55	1.65
9	1.55	1.8	2.9	3.3	2.65	3.9	2.1	1.75	1.6	1.6	1.55	2.0
10	1.6	1.9	2.85	3.3	2.65	3.8	2.1	1.75	1.6	1.55	1.55	3.45
11	1.7	1.9	2.9	3.2	2.65	3.6	2.05	1.7	1.6	1.55	1.55	3.75
12	2.8	1.9	3.9	3.05	2.6	3.45	2.0	1.7	1.6	1.55	1.55	2.45
13	2.25	2.0	3.5	2.95	2.5	3.3	2.0	1.7	1.6	1.55	1.55	2.05
14	2.1	3.2	3.15	2.9	2.75	3.15	2.0	1.7	1.6	1.55	1.55	1.9
15	2.55	3.95	2.95	2.9	2.85	3.15	2.0	1.7	1.6	1.55	1.55	1.85
16	6.15	3.35	2.7	2.9	2.6	3.1	1.95	1.7	1.6	1.55	1.55	1.85
17	3.1	2.85	2.6	2.9	2.5	2.95	1.95	1.7	1.6	1.55	1.55	1.8
18	5.95	3.2	2.55	2.9	2.4	2.85	1.95	1.7	1.6	1.55	1.55	1.7
19	5.35	3.6	2.5	2.9	2.4	2.8	1.9	1.7	1.6	1.55	1.55	1.7
20	3.35	3.55	2.5	2.9	2.35	2.65	1.9	1.7	1.6	1.55	1.55	1.7
21	3.15	4.45	3.4	2.9	2.3	2.6	1.9	1.7	1.6	1.55	1.55	1.7
22	3.1	3.95	4.4	2.9	2.3	2.55	1.85	1.7	1.6	1.55	1.55	1.7
23	3.0	3.65	4.15	3.05	2.25	2.5	1.85	1.7	1.6	1.55	1.55	1.7
24	2.9	3.8	5.5	3.05	2.2	2.4	1.85	1.7	1.6	1.55	1.55	1.7
25	2.7	3.4	6.45	3.1	2.25	2.4	1.85	1.65	1.6	1.55	1.55	2.7
26	2.6	3.2	6.3	3.0	6.6	2.4	1.85	1.65	1.6	1.55	1.55	4.7
27	2.4	3.6	5.2	2.95	6.25	2.45	1.8	1.65	1.6	1.55	1.55	4.35
28	2.2	3.4	4.4	2.95	5.3	2.4	1.8	1.65	1.6	1.55	1.55	3.45
29	2.1	......	4.0	2.9	4.5	2.35	1.8	1.65	1.6	1.55	1.55	2.9
30	2.0	......	5.25	2.9	4.1	2.3	1.8	1.65	1.6	1.55	1.55	3.1
31	1.9	......	7.4	......	3.7	......	1.8	1.65	......	1.55	......	2.85

Rating table for McCloud River near Gregory, Cal., for 1902–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	1,340	2.40	2,042	3.30	3,090	4.40	4,990	6.20	9,120
1.60	1,402	2.50	2,140	3.40	3,230	4.60	5,410	6.40	9,650
1.70	1,468	2.60	2,242	3.50	3,380	4.80	5,840	6.60	10,190
1.80	1,538	2.70	2,349	3.60	3,535	5.00	6,280	6.80	10,740
1.90	1,612	2.80	2,461	3.70	3,695	5.20	6,720	7.00	11,300
2.00	1,690	2.90	2,578	3.80	3,860	5.40	7,170	8.00	14,250
2.10	1,772	3.00	2,700	3.90	4,030	5.60	7,630		
2.20	1,858	3.10	2,825	4.00	4,210	5.80	8,110		
2.30	1,948	3.20	2,955	4.20	4,585	6.00	8,600		

NOTE.—This table is based on discharge measurements made during 1902–1906 and is well defined.

Monthly discharge of McCloud River near Gregory, Cal., for 1906.

[Drainage area, 608 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	8,990	1,370	2,540	156,000	4.18	4.82
February	5,100	1,500	2,600	144,000	4.28	4.46
March	12,400	2,140	4,160	256,000	6.84	7.89
April	7,630	2,580	3,110	185,000	5.12	5.71
May	10,200	1,860	3,070	189,000	5.05	5.82
June	9,920	1,950	3,480	207,000	5.72	6.38
July	1,950	1,540	1,690	104,000	2.78	3.20
August	1,540	1,440	1,480	91,000	2.43	2.80
September	1,400	1,400	1,400	83,300	2.30	2.57
October	1,400	1,370	1,380	84,800	2.27	2.62
November	2,000	1,370	1,400	83,300	2.30	2.57
December	5,620	1,340	2,070	127,000	3.40	3.92
The year	12,400	1,340	2,360	1,710,000	3.89	52.76

NOTE.—These values are excellent.

STONY CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Stony Creek drains a portion of the Coast Range. It flows in a northerly direction and discharges its waters into the Sacramento River near Orland, Cal. It has numerous tributaries, all of which are torrential in their character. The formation on the higher elevations is of granite, with good soil covering, and is heavily timbered. In the lower portion of the drainage basin the formation is shale, sandstone, and conglomerate, with heavy growth of brush and grass. This portion of the basin is used extensively for pasturage. The soil being heavy, it packs readily, causing a large per cent of run-off. The mean average rainfall on the higher elevation is about 40 inches, while on the lower reaches it is 20 inches. The precipitation is almost wholly in the form of rain, with some snow on the upper reaches, which soon melts and only adds to the flood discharge.

The gaging station on this stream is located near the point where it emerges from the foothills and enters the Sacramento Valley.

STONY CREEK NEAR FRUTO, CAL.

This station was established on January 30, 1901. It is located at Julian's ranch, 7 miles northwest of Fruto, and 1¾ miles above the proposed mill-site dam. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 153, where are given also references to publications that contain data for previous years.

Discharge measurements of Stony Creek near Fruto, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 8 [a]	R. S. Hawley	137	216	5.70	476
February 24	F. R. S. Buttemer	151	455	7.10	2,280
March 8	do	146	412	6.40	1,080
March 16	do	140	336	6.00	1,280
March 16	do	140	336	6.00	1,280
May 2	R. S. Hawley	136	271	5.52	789
May 18	do	132	222	5.02	497
June 13	do	132	218	5.03	491
September 20 [b]	S. G. Bennett	27	24	3.65	18
October 5 [b]	R. S. Hawley	22	17.6	3.62	18.1
October 14 [b]	S. G. Bennett	26	25	3.65	17.6

[a] During the high water of January 18, 1906, the channel at the cable was raised by a deposit of gravel, which was gradually removed during the two or three months following. These measurements were made before the channel had assumed its normal condition.

[b] Measurement made by wading at section below the gage.

Daily gage height, in feet, of Stony Creek near Fruto, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	5.8	6.75	7.85	5.4	5.3	4.5	3.8	3.6	3.7	3.7	3.8
2	4.0	5.8	6.55	7.4	5.4	5.3	4.5	3.8	3.6	3.7	3.7	3.8
3	4.0	5.8	9.35	7.05	5.3	5.3	4.4	3.8	3.6	3.7	3.8	3.8
4	4.0	5.8	7.25	6.75	5.3	5.4	4.4	3.8	3.6	3.7	3.8	3.8
5	4.0	5.8	6.7	6.55	5.3	5.3	4.3	3.8	3.6	3.7	3.9	3.8
6	4.0	5.7	6.5	6.4	5.2	5.3	4.3	3.8	3.6	3.7	3.9	3.8
7	4.0	5.7	6.5	6.3	5.2	5.3	4.2	3.8	3.6	3.7	3.9	4.2
8	4.0	5.7	6.4	6.2	5.2	5.2	4.2	3.8	3.6	3.7	3.9	4.2
9	4.0	5.7	6.4	6.1	5.2	5.2	4.2	3.8	3.6	3.7	3.9	4.3
10	4.0	5.8	6.3	6.1	5.2	5.1	4.2	3.8	3.6	3.7	3.9	5.6
11	4.0	6.0	6.95	6.0	5.1	5.1	4.2	3.8	3.6	3.7	3.9	5.6
12	6.2	6.1	6.65	6.0	5.1	5.0	4.1	3.7	3.6	3.7	3.9	5.6
13	6.65	6.0	6.45	6.0	5.1	5.0	4.1	3.7	3.6	3.7	3.9	4.8
14	7.25	7.85	6.25	5.9	5.1	5.0	4.1	3.7	3.6	3.7	3.9	4.7
15	8.0	7.35	6.05	5.9	5.1	5.0	4.1	3.7	3.6	3.7	3.9	4.6
16	12.5	6.9	6.0	5.8	5.1	5.1	4.1	3.7	3.6	3.7	3.9	4.5
17	7.6	7.25	6.0	5.7	5.0	5.0	4.1	3.7	3.6	3.7	3.9	4.5
18	14.5	7.05	5.9	5.6	5.0	5.0	4.1	3.7	3.6	3.7	3.9	4.4
19	11.0	8.0	5.8	5.6	5.0	5.0	4.1	3.7	3.6	3.7	3.9	4.4
20	8.65	7.5	5.8	5.5	5.0	4.9	4.1	3.7	3.6	3.7	3.9	4.3
21	7.65	7.45	6.9	5.5	5.0	4.9	4.1	3.7	3.6	3.7	3.9	4.3
22	7.1	7.25	6.65	5.4	5.0	4.9	4.0	3.7	3.6	3.7	3.9	4.2
23	6.75	7.15	8.0	5.5	5.0	4.8	4.0	3.7	3.7	3.7	3.9	4.2
24	6.55	7.1	7.6	5.5	5.1	4.8	4.0	3.7	3.7	3.7	3.9	4.2
25	6.35	7.0	8.25	5.5	5.2	4.8	3.9	3.7	3.7	3.7	3.8	4.2
26	6.25	6.8	7.65	5.4	5.3	4.8	3.9	3.6	3.7	3.7	3.8	9.0
27	6.1	7.15	7.45	5.4	5.5	4.8	3.9	3.6	3.7	3.7	3.8	7.8
28	6.1	7.05	7.25	5.5	5.95	4.8	3.9	3.6	3.7	3.7	3.8	6.3
29	6.0	....	7.05	5.5	5.65	4.7	3.8	3.6	3.7	3.7	3.8	5.65
30	5.9	....	11.0	5.5	5.5	4.6	3.8	3.6	3.7	3.7	3.8	5.2
31	5.8	....	8.35	....	5.4	....	3.8	3.6	....	3.7	....	4.9

Rating table for Stony Creek near Fruto, Cal., from March 8, 1906, to December 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.60	13	4.40	213	5.20	580	6.00	1,250	7.60	3,150
3.70	29	4.50	250	5.30	640	6.20	1,400	7.80	3,410
3.80	48	4.60	290	5.40	705	6.40	1,680	8.00	3,660
3.90	70	4.70	335	5.50	780	6.60	1,905	9.00	5,270
4.00	93	4.80	380	5.60	865	6.80	2,140	10.00	7,280
4.10	119	4.90	430	5.70	955	7.00	2,390	11.00	10,200
4.20	149	5.00	480	5.80	1,050	7.20	2,640		
4.30	179	5.10	530	5.90	1,150	7.40	2,890		

NOTE.—This table is based on 9 discharge measurements made during 1906 and 3 during 1904, and is well defined below gage height 6.4 feet.

Monthly discharge of Stony Creek near Fruto, Cal., for 1906.

[Drainage area, 700 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	22,200	150	2,230	137,000	2.93	3.38
February	3,320	480	1,540	85,500	2.03	2.11
March	10,200	1,050	2,500	154,000	3.29	3.79
April	3,480	705	1,280	76,200	1.68	1.87
May	1,200	480	610	37,500	.803	.93
June	705	290	495	29,500	.651	.73
July	250	48	127	7,800	.167	.19
August	48	13	32.6	2,000	.043	.05
September	29	13	17.3	1,030	.023	.03
October	29	29	29.0	1,780	.034	.04
November	70	29	61.4	3,650	.081	.09
December	5,270	48	582	35,800	.766	.88
The year	22,200	13	792	572,000	1.04	14.10

NOTE.—Discharges were obtained from the 1905 table, January 1 to 15, and by the indirect method for shifting channels, January 16 to March 7. Values are rated as follows: March to July and December, good; remainder of 1906, fair.

MISCELLANEOUS MEASUREMENTS IN STONY CREEK DRAINAGE BASIN.

The following miscellaneous measurements were made of Stony Creek just above its junction with Little Stony Creek:

September 18: Width, 26 feet; area, 38 square feet; discharge, 26 second-feet.
October 13: Width, 26 feet; area, 34 square feet; discharge, 21 second-feet.

CACHE CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Cache Creek drains that portion of the eastern slope of the Coast Range directly north from the Puta Creek basin. This basin is long and narrow, extending from northwest to southeast; it has numerous tributaries, of which North Fork is the largest. Most of these tributaries are torrential in their character, but the flow of the main stream is regulated largely by its discharge from Clear Lake, which is fed by numerous creeks having their source in the higher portion of the drainage basin. The lake covers an area of 65 square miles, and has a drainage area of 417 square miles. The streams that enter Cache Creek below Clear Lake are practically dry during the summer months. There are large cultivated areas on the west side of Clear Lake, a greater portion of which is meadow land used for stock raising. There are two gaging stations located on this stream—one at Lower Lake directly at the point where the stream discharges from the lake and one at Yolo a short distance below where it emerges from the foothills. There are numerous diversions above the gaging station at Yolo which take practically the entire flow during the summer months. This water is used for irrigation in the vicinity of Woodland and Yolo, where the soil is rich and deep and susceptible of the highest state of cultivation.

CACHE CREEK AT LOWER LAKE, CAL.

This station was established January 1, 1900. It is located three-fourths mile from Lower Lake, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 169, where are given also references to publications that contain data for previous years. The following measurement was made March 7, 1906:

Width, 64 feet; area, 301 square feet; gage height, 6.80 feet; discharge, 999 second-feet.

Daily gage height, in feet, of Cache Creek at Lower Lake, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	5.35	6.35	8.9	7.0	5.85	5.1	4.35	3.65	3.2	2.9	2.7
2	2.5	5.3	6.25	8.9	6.9	5.85	5.1	4.3	3.6	3.25	2.85	2.75
3	2.5	5.3	7.2	8.95	6.9	5.8	5.05	4.3	3.6	3.25	2.85	2.75
4	2.5	5.3	6.75	8.9	6.8	5.8	5.05	4.3	3.6	3.2	2.85	2.75
5	2.5	5.3	6.8	8.9	6.75	5.75	5.0	4.25	3.6	3.2	2.85	2.7
6	2.5	5.3	6.8	8.85	6.65	5.75	5.0	4.25	3.55	3.15	2.9	2.7
7	2.45	5.25	6.8	8.85	6.6	5.7	4.95	4.25	3.55	3.15	2.9	2.7
8	2.5	5.25	6.8	8.8	6.55	5.7	4.95	4.25	3.55	3.15	2.9	2.7
9	2.45	5.25	6.8	8.8	6.5	5.65	4.9	4.2	3.55	3.15	2.9	2.8
10	2.5	5.25	6.8	8.75	6.45	5.6	4.85	4.2	3.4	3.15	2.9	3.15
11	2.5	5.25	6.8	8.55	6.5	5.6	4.85	4.15	3.4	3.2	2.9	3.35
12	2.75	5.2	7.1	8.45	6.35	5.55	4.8	4.15	3.45	3.2	2.95	3.3
13	2.9	5.2	7.1	8.35	6.35	5.5	4.8	4.1	3.5	3.15	2.95	3.3
14	3.05	6.1	7.3	8.3	6.5	5.5	4.8	4.1	3.45	3.1	2.95	3.3
15	3.2	5.4	7.0	8.4	6.35	5.45	4.75	4.05	3.4	3.1	2.95	3.35
16	4.75	5.4	7.0	8.2	6.3	5.45	4.7	4.0	3.35	3.15	2.9	3.4
17	4.0	5.4	7.0	8.0	6.25	5.5	4.7	3.95	3.35	3.1	3.0	3.4
18	5.18	5.5	6.9	7.9	6.2	5.4	4.65	3.95	3.35	3.1	2.9	3.4
19	5.2	5.6	6.8	7.75	6.15	5.4	4.65	3.9	3.3	3.0	2.85	3.4
20	5.3	5.9	7.2	7.65	6.1	5.45	4.6	3.85	3.3	3.0	2.85	3.4
21	5.3	5.8	7.3	7.6	6.05	5.4	4.6	3.85	3.3	2.95	2.95	3.4
22	5.4	5.9	7.2	7.4	6.0	5.35	4.55	3.85	3.25	2.9	2.8	3.4
23	5.4	6.1	7.5	7.4	5.9	5.3	4.55	3.8	3.35	2.9	2.8	3.35
24	5.4	6.2	7.6	7.35	5.85	5.3	4.4	3.8	3.35	2.9	2.85	3.35
25	5.45	6.2	7.75	7.3	5.9	5.25	4.5	3.8	3.25	2.9	2.85	3.4
26	5.4	6.2	8.05	7.25	5.95	5.25	4.45	3.75	3.25	2.9	2.8	3.75
27	5.4	6.4	8.1	7.5	6.0	5.25	4.45	3.75	3.25	2.9	2.75	3.7
28	5.4	6.5	8.1	7.2	5.95	5.2	4.4	3.7	3.25	2.9	2.75	3.75
29	5.4	....	8.1	7.1	5.95	5.15	4.4	3.7	3.2	2.9	2.8	3.8
30	5.4	......	8.8	7.0	5.9	5.1	4.4	3.7	3.2	2.9	2.75	3.9
31	5.35	......	9.3	....	5.9	......	4.35	3.65	....	2.9	....	4.0

Rating table for Cache Creek at Lower Lake, Cal., for 1905–6.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-height.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	27	3.30	135	4.20	296	5.20	552	7.00	1,120
2.50	37	3.40	149	4.30	318	5.40	610	7.20	1,188
2.60	48	3.50	163	4.40	341	5.60	670	7.40	1,256
2.70	59	3.60	178	4.50	365	5.80	732	7.60	1,324
2.80	71	3.70	194	4.60	390	6.00	795	7.80	1,392
2.90	83	3.80	212	4.70	416	6.20	859	8.00	1,460
3.00	95	3.90	232	4.80	442	6.40	923	9.00	1,840
3.10	108	4.00	252	4.90	469	6.60	988		
3.20	121	4.10	274	5.00	496	6.80	1,054		

NOTE.—This table is based on discharge measurements made during 1904-6 and is well defined below gage height 7 feet.

Monthly discharge of Cache Creek at Lower Lake, Cal., for 1906.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	625	32	316	19,400	0.632	0.73
February	955	552	676	37,500	1.35	1.41
March	1,960	875	1,220	75,000	2.44	2.81
April	1,820	1,120	1,510	89,800	3.02	3.37
May	1,120	748	804	55,000	1.79	2.06
June	748	524	639	38,000	1.28	1.43
July	524	330	423	26,000	.846	.98
August	330	186	256	15,700	.512	.59
September	186	121	150	8,930	.300	.33
October	128	83	103	6,330	.206	.24
November	95	65	79.4	4,720	.159	.18
December	252	59	133	8,180	.266	.31
The year	1,960	32	533	385,000	1.07	14.44

NOTE.—These values are excellent.

CACHE CREEK NEAR YOLO, CAL.

This station was established January 1, 1903. It is located at the wagon bridge on the road from Woodland to Yolo, about 1,000 feet above the Southern Pacific Railroad bridge. A new wagon bridge, which greatly improves the channel conditions, was erected during 1904. The station was reestablished on the new bridge December 4, 1904. Numerous diversions are made from Cache Creek above this station which take practically all of the summer flow. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 172, where are given also references to publications that contain data for previous years.

Discharge measurements of Cache Creek near Yolo, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 5	F. R. S. Buttemer	93	262	3.88	850
February 16	do	97	445	5.15	1,600
February 20	do	97	479	5.79	2,090
March 5	do	102	578	6.60	2,580
March 13	do	102	592	6.85	2,540
April 13	R. S. Hawley	99	482	6.05	2,090
April 24	W. C. Sawyer	97	428	5.36	1,810
May 1	do	96	380	4.95	1,520
May 6	do	83	127	2.25	254
May 7	do	133	2,180	19.95	11,800
May 7	do	133	2,150	19.72	10,900
May 7	do	133	2,230	20.40	12,100
May 7	do	133	2,240	20.43	11,300
May 7	do	133	2,270	20.65	12,000
May 8	do	98	400	4.99	1,540
May 15	do	96	338	4.49	1,240
July 13	R. S. Hawley	92	160	2.50	321
July 30	do	91	137	2.10	224
October 4	do	10	28	1.00	3.3

NOTE.—A landslide occurred in Cache Creek canyon, above the station, on May 2, damming the flow. This dam was overtopped on May 7, when the creek rose to a maximum gage height of 20.8 feet. The measurements of this date were made at the crest of the flood.

Daily gage height, in feet, of Cache Creek near Yolo, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.05	5.5	10.0	5.0	4.3	3.1	2.15	1.65	1.1	0.85	
2		4.0	5.2	8.6	4.55	4.2	3.1	2.1	1.65	1.1	.85	
3		3.95	5.55	8.0	2.95	4.15	3.05	2.0	1.6	1.95	.85	
4		3.95	8.5	7.6	2.6	4.1	3.0	2.0	1.6	1.9	.8	
5		3.9	6.7	7.3	2.25	4.1	3.0	2.0	1.6	1.05	.8	
6		3.85	6.15	7.0	2.2	4.05	2.8	1.95	1.6	1.0	.8	
7		3.85	5.85	6.8	12.1	4.0	2.65	1.95	1.5	1.0	.8	
8		3.8	5.6	6.7	5.1	3.95	2.6	1.95	1.5	1.0	.8	
9		3.75	5.5	6.6	4.7	3.9	2.6	1.95	1.5	1.0	.8	
10		3.75	5.4	6.4	4.6	3.85	2.6	2.0	1.5	1.0	.8	
11		3.7	5.3	6.35	4.6	3.8	2.5	2.0	1.5	1.0	.8	5.75
12		3.7	9.3	6.3	4.55	3.8	2.5	2.0	1.5	1.0	.75	3.3
13	4.35	3.7	7.25	6.1	4.6	3.8	2.5	2.0	1.45	1.0	.75	2.7
14	6.3	3.7	6.45	6.0	4.5	3.75	2.5	2.0	1.45	.95	.75	2.5
15	4.45	6.85	6.0	5.9	4.45	3.7	2.45	2.0	1.45	.95	.75	2.45
16	9.9	5.2	5.8	5.8	4.4	3.65	2.45	2.0	1.45	.95	.7	2.45
17	14.0	4.7	5.6	5.7	4.35	3.65	2.45	1.95	1.45	.9		2.45
18	14.05	5.45	5.5	5.75	4.3	3.65	2.4	1.95	1.45	.9		2.4
19	25.7	6.65	5.4	5.65	4.3	3.6	2.35	1.95	1.45	.9		2.4
20	10.25	5.8	5.3	5.55	4.25	3.5	2.3	1.8	1.35	.9		2.4
21	6.75	7.8	7.25	5.45	4.2	3.4	2.3	1.7	1.3	.9		2.4
22	5.8	7.25	7.0	5.4	4.15	3.4	2.3	1.7	1.3	.9		2.4
23	5.35	6.4	6.7	5.4	4.1	3.35	2.35	1.65	1.3	.9		2.4
24	5.05	8.3	10.7	5.3	4.05	3.3	2.3	1.7	1.25	.9		2.4
25	4.8	7.45	9.95	5.25	4.2	3.25	2.3	1.75	1.25	.85		2.4
26	5.6	6.0	11.0	5.2	4.55	3.2	2.25	1.75	1.2	.85		4.2
27	4.4	5.65	9.25	5.15	4.7	3.2	2.2	1.7	1.15	.85		7.55
28	4.3	5.8	7.95	5.3	4.85	3.2	2.2	1.7	1.15	.85		3.95
29	4.2		7.3	5.2	4.7	3.2	2.2	1.65	1.1	.85		3.3
30	4.15		9.65	5.1	4.45	3.15	2.15	1.65	1.1	.85		3.1
31	4.1		15.85		4.35		2.15	1.65		.85		2.8

NOTE.—The creek was dry January 1 to 12 and November 17 to December 10. The gage height for May 7 is the mean of a large number of readings at short intervals.

Rating table for Cache Creek near Yolo, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	0	1.80	145	2.60	358	3.40	650	4.40	1,168
1.00	3	1.90	169	2.70	388	3.50	692	4.60	1,284
1.10	17	2.00	193	2.80	420	3.60	737	4.80	1,405
1.20	32	2.10	217	2.90	455	3.70	785	5.00	1,537
1.30	48	2.20	243	3.00	491	3.80	835	5.20	1,671
1.40	65	2.30	271	3.10	530	3.90	887	5.40	1,805
1.50	85	2.40	299	3.20	570	4.00	941	5.60	1,939
1.60	105	2.50	328	3.30	610	4.20	1,053	5.80	2,073
1.70	125								

NOTE.—This table is based on discharge measurements made during 1906 and is well defined between gage heights 1 foot and 7 feet. Above gage height 5 feet the rating curve is a tangent, the difference being 67 per tenth.

Monthly discharge of Cache Creek near Yolo, Cal., for 1906.

[Drainage area, 1,280 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	15,400	0	2,000	123,000	1.56	1.80
February	3,750	785	1,660	92,200	1.30	1.35
March	8,810	1,670	3,040	187,000	2.38	2.74
April	4,890	1,600	2,360	140,000	1.84	2.05
May	6,290	243	1,270	78,100	.992	1.14
June	1,110	550	784	46,700	.613	.68
July	530	229	333	20,500	.260	.30
August	229	115	166	10,200	.130	.15
September	115	17	69.4	4,130	.054	.06
October	181	0	13.6	836	.011	.01
November	0	0	0	0	.00	1.00
December	3,250	0	435	26,700	.340	.39
The year	15,400	0	1,010	729,000	.790	10.67

NOTE.—Values are rated as follows: January and September, good; October, fair; remainder of 1906, excellent.

PUTA CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Puta Creek drains a portion of the eastern slope of the Coast Range, its waters discharging into Sacramento River, through what is known as the Yolo basin, in the vicinity of Davis, Cal. This basin is rather long and narrow, extending from west to east; it has numerous tributaries which have a heavy flood discharge during the winter months, but are practically dry during the summer. This stream is torrential in its flow. It has a comparatively small drainage basin with an exceptionally heavy rainfall, especially on the higher elevations in the vicinity of Mount St. Helena. A five-year rainfall record at Helen Mine, on the northern slope of Mount St. Helena, gives an average of 99.52 inches. The precipitation is less at lower elevations. The upper reaches of the basin are well timbered, but the lower part is comparatively barren of timber, though it has a considerable growth of brush extending to a point where the stream leaves the foothills.

The areas in the lower portion of the basin are used principally for pasturage. The topography of the country is rough and precipitous. The underlying rock is an impervious slate and serpentine, with a thin soil covering. There is comparatively little tilled land in the basin above where the stream emerges from the foothills at Winters. Below this point the soil is deep and susceptible to high cultivation, and at present is used for raising grain and fruit.

PUTA CREEK NEAR GUENOC, CAL.

This station was established February 12, 1904. It is located about 2 miles below the old town of Guenoc, near the Asbill ranch house and at the Guenoc dam site. The nearest post-office is at Middletown, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 180, where are given also references to publications that contain data for previous years.

Discharge measurements of Puta Creek near Guenoc, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 15[a]	S. Asbill	145	1,300	10.55	8,250
January 16[a]	do	152	1,800	14.25	12,500
January 23	do	126	970	8.60	3,540
January 23	do	124	868	8.00	2,930
January 24	do	124	830	7.80	3,280
January 24	do	125	815	7.90	3,070
February 15	do	94	202	6.25	830
February 15	do	94	229	6.35	943
March 6	R. S. Hawley	93	153	5.59	479
March 7	do	93	136	5.50	405
March 19	do	82	167	5.48	379
March 20	do	114	480	7.00	1,950
March 21	do	104	320	6.52	1,230
April 17	do	82	78	5.00	175
April 18	do	82	78	4.99	168
May 7	do	[b] 32	[a] 39	4.84	118
May 8	do	[b] 32	[b] 37	4.82	108
July 27	do	[b] 20	[b] 13.2	4.29	18.2
July 28	do	[b] 20	[b] 13.2	4.28	18.1

[a] Measured by floats.

[b] Wading section.

Daily gage height, in feet, of Puta Creek, near Guenoc, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1	3.7	4.9	5.5	6.3	4.9	5.0	4.6
2	3.7	4.9	6.0	6.1	4.9	5.2	4.6
3	3.7	4.9	6.65	6.0	4.9	5.9	4.6
4	3.7	4.9	6.35	5.8	4.8	5.4	4.6
5	3.7	4.8	5.8	5.7	4.8	5.1	4.5
6	3.7	4.8	5.4	5.6	4.8	5.1	4.5
7	3.7	5.0	5.4	5.6	4.8	5.0	4.5
8	3.7	4.9	5.3	5.6	4.8	5.0	4.4
9	3.7	4.9	5.3	5.5	4.8	5.0	4.4
10	3.7	4.8	5.3	5.5	4.8	5.0	4.4
11	4.0	7.0	5.3	5.4	4.8	5.5	4.4
12	8.5	6.9	5.2	5.4	4.8	5.3	....
13	9.2	6.45	5.4	5.4	4.8	5.2	....
14	10.5	6.35	5.6	5.3	4.8	5.1	....
15	10.0	5.55	5.5	5.2	4.8	5.0	4.3

Daily gage height, in feet, of Puta Creek, near Guenoc, Cal., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
16	11.05	5.4	5.4	5.1	4.8	5.0	4.3
17	9.55	5.7	5.4	5.0	4.8	4.9	4.3
18	13.25	6.2	5.5	4.9	....	4.9	4.3
19	8.25	6.5	5.5	4.9	4.8	4.8	4.3
20	6.15	6.6	6.4	4.9	4.8	4.8	4.3
21	5.7	6.45	6.35	4.8	4.8	4.8	4.3
22	5.6	6.6	6.35	4.9	4.8	....	4.3
23	5.45	7.15	7.4	5.1	4.8	4.7	4.3
24	5.35	7.4	8.1	5.1	4.8	4.7	4.3
25	5.25	6.5	7.8	5.0	6.8	4.7	4.3
26	5.2	6.1	7.5	5.0	6.6	4.7	4.2
27	5.2	5.8	6.3	5.0	5.65	4.7	4.2
28	5.1	5.65	6.3	5.0	5.4	4.6	4.2
29	5.05	....	6.3	4.9	5.25	4.6	4.2
30	5.0	....	6.4	4.9	5.1	4.6	4.2
31	5.0	....	7.8	....	5.0	....	4.2

Rating table for Puta Creek near Guenoc, Cal., for 1906.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.00	1	5.00	155	6.00	680	7.00	1,720	9.00	4,640
4.10	4	5.10	190	6.10	760	7.20	1,960	9.20	5,000
4.20	9	5.20	230	6.20	850	7.40	2,200	9.40	5,360
4.30	19	5.30	270	6.30	940	7.60	2,480	9.60	5,720
4.40	29	5.40	315	6.40	1,035	7.80	2,760	9.80	6,080
4.50	43	5.50	365	6.50	1,135	8.00	3,040	10.00	6,440
4.60	63	5.00	420	6.60	1,240	8.20	3,340	11.00	8,240
4.70	83	5.70	480	6.70	1,360	8.40	3,650	12.00	10,040
4.80	105	5.80	540	6.80	1,480	8.60	3,970	13.00	11,840
4.90	129	5.90	610	6.90	1,600	8.80	4,300		

NOTE.—This table is based on discharge measurements made during 1906, and is well defined between gage heights 4.3 feet and 8 feet.

Monthly discharge of Puta Creek near Guenoc, Cal., for 1906.

[Drainage area, 91 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	12,300	0	1,800	111,000	19.78	22.81
February	2,200	105	727	40,400	7.99	8.32
March	3,190	230	916	56,300	10.07	11.61
April	940	105	302	18,000	3.32	3.70
May	1,480	105	215	13,200	2.36	2.72
June	365	63	165	9,820	1.81	2.02
July	63	9	26.8	1,650	0.294	0.34
The period				250,000		

NOTE.—Discharges interpolated for days when gage was not read. Values are rated as follows: January and July, good; remainder of the period, excellent.

PUTA CREEK AT WINTERS, CAL.

This station was established September 26, 1905. It is located about 450 feet below the Southern Pacific Railroad bridge and about 800 feet southeast of the depot at Winters, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, pages 182–182.

Discharge measurements of Puta Creek at Winters, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 20	R. S. Hawley	178	1,240	9.90	3,820
February 3	F. R. S. Buttemer	170	287	5.10	325
February 15	do	182	1,300	10.55	4,660
February 22	do	180	809	8.50	2,950
March 6	do	178	410	7.02	1,400
March 14	do	179	636	8.15	2,430
May 4	R. S. Hawley	128	160	6.00	390
May 15	do	123	146	5.80	287
June 8	do	150	134	5.78	325
July 5	do	80	75	4.90	107
July 26	do	50	44	4.75	31
July 27	do	50	46	4.75	34
August 14	do	50	26	4.62	22
August 15	do	50	24	[a] 4.79	19.3
September 8	do	50	20	4.70	14.5

[a] New gage; old gage reading 4.60 feet.

NOTE.—Measurements of May 4 and after were made by wading 200 feet above the cable.

Daily gage height, in feet, of Puta Creek at Winters, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.60	5.28	6.58	10.00	[a] 6.10	6.00	4.95	4.70	4.75	4.70	4.75	4.90
2	4.61	5.20	6.35	8.85	[a] 6.10	5.80	4.90	4.70	4.75	4.70	4.70	4.90
3	4.62	5.10	11.20	8.00	[a] 6.05	5.75	4.90	4.70	4.75	4.70	4.75	4.90
4	4.62	5.05	10.10	7.80	6.00	5.80	4.85	4.75	4.80	4.65	4.85	[a] 4.90
5	4.63	5.00	7.62	7.50	[a] 6.00	6.00	4.80	4.75	4.75	4.65	4.90	4.90
6	4.64	4.95	7.00	7.35	5.95	5.90	4.80	4.75	4.75	4.65	4.90	4.90
7	4.64	4.93	6.88	7.15	5.90	5.80	4.75	4.80	4.70	4.65	4.90	[a] 4.95
8	4.63	4.90	6.60	7.05	5.90	5.80	4.75	4.80	4.70	4.65	4.95	5.00
9	4.64	4.87	6.45	6.95	5.85	5.70	4.65	4.80	4.70	4.65	4.95	4.90
10	4.64	4.85	[a] 6.30	6.85	5.80	5.60	4.65	4.80	4.70	[a] 4.70	4.90	5.20
11	4.66	4.90	6.20	6.75	5.80	5.60	4.65	4.75	4.70	4.70	4.90	10.70
12	4.85	5.00	11.40	6.70	5.80	5.55	4.60	4.85	4.70	4.75	4.90	6.95
13	10.76	4.90	9.05	6.60	[a] 5.80	5.70	4.60	4.8	[a] 4.70	[a] 4.75	4.85	6.30
14	13.00	4.90	8.28	6.50	5.80	5.55	4.60	4.75	4.70	4.75	4.85	6.00
15	10.75	12.50	7.90	6.50	5.80	5.50	4.60	[b] 4.80	4.70	4.70	4.85	5.75
16	21.60	7.33	7.38	6.50	5.85	5.50	4.60	4.75	4.70	4.70	4.85	5.70
17	12.20	6.60	7.12	6.40	5.80	5.45	4.55	[a] 4.75	4.70	4.70	4.85	5.60
18	22.85	7.15	6.85	6.30	5.70	5.40	4.55	4.70	4.65	4.70	4.85	5.50
19	24.00	8.26	7.75	6.30	5.70	5.35	4.80	4.75	4.70	4.70	4.85	5.40
20	10.80	7.10	7.60	6.30	5.70	5.20	4.70	4.75	4.65	4.70	4.85	5.35
21	8.45	10.08	11.09	6.30	5.65	5.20	4.70	4.75	[a] 4.70	4.65	4.85	5.30
22	7.40	8.60	8.75	6.25	5.60	5.10	4.75	4.75	4.70	4.65	4.85	5.30
23	6.91	7.55	9.65	6.30	5.60	5.10	4.75	4.70	4.70	4.70	[a] 4.85	5.35
24	6.70	8.90	13.50	6.30	5.60	5.15	4.7	4.70	4.70	4.70	4.85	[a] 5.35
25	6.35	[a] 8.00	11.80	6.25	5.60	5.20	4.75	4.70	4.70	4.70	4.85	5.35
26	6.00	7.10	11.85	6.20	6.60	5.10	4.75	4.75	4.70	4.70	4.85	13.90
27	5.82	6.75	9.70	6.20	[a] 6.80	5.30	4.75	4.70	4.70	[a] 4.70	4.90	10.00
28	5.70	6.88	8.50	6.20	7.00	5.00	4.75	4.75	[a] 4.70	4.70	4.90	7.35
29	5.55	..	7.88	[a] 6.15	6.50	5.10	4.75	[a] 4.75	4.70	4.75	4.90	6.75
30	5.45	..	8.50	[a] 6.15	6.15	5.00	4.70	4.75	4.70	4.75	4.90	6.40
31	5.35	..	15.50	..	6.05	..	4.70	4.70	..	4.75	..	6.40

[a] Gage height estimated.

[b] A new gage was put in August 15 and read after that date.

Daily discharge, in second-feet, of Puta Creek at Winters, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	22	360	1,080	4,140	480	450	139	29	18	14	18	40
2	22	380	880	3,020	480	350	131	29	18	14	14	40
3	22	330	5,540	2,210	435	315	123	28	18	14	18	40
4	22	290	4,420	2,020	390	350	115	28	24	10	31	40
5	25	250	2,020	1,740	390	450	107	27	18	10	40	40
6	25	220	1,440	1,600	365	400	104	27	18	10	40	40
7	25	200	1,300	1,420	340	350	101	26	14	10	40	52
8	25	150	1,050	1,330	340	350	98	26	14	10	52	64
9	25	120	920	1,240	315	301	95	25	14	10	52	40
10	25	100	780	1,150	290	294	92	25	14	14	40	116
11	25	100	680	1,060	290	287	89	24	14	14	40	4,790
12	46	110	5,640	1,010	290	280	86	24	14	18	40	1,205
13	4,840	80	3,280	920	290	273	83	23	14	18	31	640
14	7,140	70	2,530	830	290	266	80	22	14	18	31	400
15	4,840	6,620	2,170	830	290	259	76	24	14	14	31	290
16	17,800	1,600	1,700	830	315	252	72	18	14	14	31	273
17	6,300	980	1,430	750	290	245	68	18	14	14	31	239
18	19,400	1,530	1,200	660	250	238	64	14	10	14	31	206
19	20,900	2,610	2,010	660	250	231	60	18	14	14	31	173
20	4,800	1,570	1,870	660	250	224	56	18	10	14	31	160
21	2,480	4,440	5,160	660	230	217	52	18	14	10	31	145
22	1,600	3,040	2,950	610	210	210	48	18	14	10	31	145
23	1,160	2,040	3,810	660	210	203	44	14	14	14	31	160
24	970	3,310	7,760	660	210	195	40	14	14	14	31	160
25	800	2,440	5,950	610	210	187	36	14	14	14	31	160
26	560	1,600	6,000	570	895	179	32	18	14	14	31	8,130
27	470	1,240	3,850	570	1,070	171	32	14	14	14	40	4,090
28	430	1,360	2,710	570	1,250	163	31	18	14	14	40	1,565
29	400	....	2,130	525	810	155	31	18	14	18	40	1,025
30	380	....	2,700	525	530	147	30	18	14	18	40	725
31	360	....	10,040	....	480	....	30	14	....	18	....	725

NOTE.—These discharges were obtained by the indirect method for shifting channels, except for the high water in January, which are based on a rating table, using high-water measurements made in January, 1907.

Monthly discharge of Puta Creek at Winters, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	20,900	22	3,100	191,000
February	6,620	70	1,330	73,900
March	10,000	680	3,060	188,000
April	4,140	525	1,130	67,200
May	1,250	210	411	25,300
June	450	147	266	15,800
July	139	30	72.4	4,450
August	29	14	21.0	1,290
September	24	10	14.7	875
October	18	10	13.7	842
November	52	14	34.0	2,020
December	8,130	40	836	51,400
The year	20,900	10	857	622,000

NOTE.—The discharge for gage heights above 11 feet is based on measurements made in January, 1907. Values are rated fair.

FEATHER RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Feather River drains a portion of the western slope of the Sierra Nevada extending east nearly to the Nevada State line, a distance of about 75 miles, and north and south for a distance of from 30 to 40 miles.

The greater portion of the watershed is rough and mountainous and has numerous tributaries which drain the slopes of the higher mountains. The formation in the southern and eastern part of the basin is of granite, with a comparatively deep soil covering. There is also a considerable area composed of lava and other volcanic matter in the northern part of the basin. Numerous meadows and valleys also exist, which tend to maintain a steady flow during the dry season. The soil is generally porous and absorbs the moisture readily. The entire watershed is well covered with a growth of brush and timber, much of which is large enough to make lumbering a profitable industry, with the exception of the meadow lands and valleys, which are used for stock ranges and grazing lands. There are numerous large springs, especially in the lava districts, which supply a more or less steady flow throughout the year. These are especially noticeable on North Fork, where there are perennial springs discharging from 50 to 100 second-feet. There is little artificial storage in the drainage area, and the water used for irrigation in the valleys is taken from the natural flow of the streams.

The mean annual precipitation is probably from 40 to 60 inches and is well distributed over the area. It falls largely in the form of snow, but disappears in the early part of the summer.

The drainage basin of North Fork of Feather River lies in the high sierra almost wholly in the northwestern portion of Plumas County. The junction of North Fork with East Fork, or Feather River proper, is in the western part of Plumas County, about 40 miles north of Oroville and 15 miles south of Prattville. The entire length of the North Fork basin does not exceed 40 miles, and its area is probably less than 1,000 square miles. This basin is rough and mountainous, though there are many large valley meadows above Prattville ranging in elevation from 4,000 to 6,000 feet. The formation consists of broken and porous lava and other volcanic matter, especially in the upper reaches, where numerous cones, craters, ashes, and lakes indicate recent volcanic activity. There is a good covering of porous soil, which absorbs moisture readily and equalizes the annual flow in the large number of tributaries in the basin. Except in the case of the highest peaks, like Lassen Peak, with elevation of 10,437 feet, which are rocky and barren, there is a good growth of timber and brush, and on the higher slopes this growth becomes comparatively heavy and suitable for lumbering. A large per cent of the area, however, is meadow land, which permits profitable stock raising.

This basin has a mean annual precipitation of from 40 to 60 inches, a large percentage of which occurs as snow. A good portion of the rainfall and snow is collected and conserved in the numerous lakes on the higher elevations near the divide, but by far the greater percentage of the precipitation in this basin percolates through the porous surface soil into the vast beds of broken lava and volcanic gravels and sands beneath, where it is impounded in subterranean reservoirs. From the melting snows above and the perennial underground basins below a well-regulated flow issues from the highest reaches through the numerous mountain streams which gather into a few good-sized channels in the meadows below the higher elevations. These underground reservoirs also supply the many large perennial springs which issue from the borders of the meadows with discharges of from 50 to 100 second-feet. One of the largest of these springs is Dotta Spring, about 3 miles east of Prattville; it has a maximum discharge of 100 second-feet and a minimum of 70 second-feet.

As yet no irrigation or power developments of importance have been made, but the Great Western Power Company has carefully investigated the stream flow near Prattville and the storage possibilities in a portion of Big Meadows with a view to early development.

The watershed above Prattville is divided into two smaller basins of almost equal size, the eastern basin being drained by what is known as Hamilton Branch and its tributaries and the western basin by North Fork and its tributaries. The eastern basin ranges in elevation from 4,300 to 7,500 feet, has an area of 230 square miles, and includes the East Arm of Big Meadows and the large, level area called Mountain Meadows, but its run-off is only about half as large as that from the western basin, which has an area of 245 square miles varying in elevation from 4,300 to 10,000 feet and including the West Arm of Big Meadows and the higher elevations about Lassen Peak. Hamilton Branch and North Fork unite about 3 miles east of Prattville in the lower edge of Big Meadows. A gaging station is maintained on each stream a short distance above the point of confluence.

For the purpose of studying the water resources of North Fork of Feather River the Great Western Power Company has established and maintained a number of regular stations in the basin at which complete records are kept. These stations were established in the summer of 1905 by W. E. Spear under the direction of John R. Freeman, consulting engineer for the company. During 1906 they were maintained by L. J. Bevan under the direction of Vielé, Cooper & Blackwell, consulting engineers for the company.

FEATHER RIVER AT OROVILLE, CAL.

This station was established January 1, 1902. It is located at the northeast edge of the town of Oroville, Cal., where Feather River breaks from the foothills on the western slope of the Sierra Nevada into Sacramento Valley. The drainage area is 3,640 square miles. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 155, where are given also references to publications that contain data for previous years.

Discharge measurements of Feather River at Oroville, Cal., by Hawley and Sawyer, in 1906.

Date.	Width.	Area of section.	Gage height.[a]	Discharge.	Date.	Width.	Area of section.	Gage height.[a]	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 16	291	4,600	9.00	11,500	May 2	309	4,760	10.88	18,800
February 28	311	5,340	11.35	19,600	May 11	312	5,270	11.95	22,100
March 15	307	5,260	10.90	18,400	May 17	298	4,280	9.30	12,600
March 22	316	5,810	12.72	23,000	July 6	279	3,240	6.25	7,190
March 25	340	7,280	17.00	48,600	July 26	273	2,380	3.10	2,800
April 11	309	4,830	11.25	18,400	September 5	272	2,100	1.90	1,760
April 16	309	4,840	11.14	18,100	October 12	271	2,060	1.73	1,620
April 25	307	4,620	10.61	17,000	November 1	272	2,060	1.73	1,610
April 25	307	4,560	10.42	16,600	December 10	274	2,410	3.05	3,270

[a] Gage heights refer to the gage at the station.

Daily gage height, in feet, of Feather River at Oroville, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.95	5.45	10.4	14.7	10.65	10.7	6.1	2.95	2.05	1.8	1.8	1.9
2	.95	5.0	9.5	13.3	10.95	10.35	6.0	2.9	2.0	1.8	1.8	1.9
3	.9	4.7	9.5	13.1	11.85	11.1	6.8	2.9	2.0	1.8	2.5	1.9
4	.95	4.7	9.4	12.6	11.5	13.0	6.55	2.85	1.95	1.8	6.95	1.9
5	.85	4.75	9.6	12.1	12.0	11.7	6.45	2.8	1.9	1.8	5.25	1.9
6	.85	5.2	8.4	12.2	12.05	11.3	6.65	2.8	1.9	1.8	3.5	1.9
7	.85	5.3	8.3	10.35	12.2	10.6	6.55	2.75	1.9	1.8	2.5	1.9
8	.85	5.35	8.3	10.15	12.05	9.6	6.4	2.7	1.9	1.8	2.0	[a]3.3
9	.9	5.45	8.15	10.15	12.1	10.45	6.3	2.7	1.85	1.8	2.0	4.7
10	1.0	5.6	8.1	11.4	12.05	9.95	6.1	2.65	1.85	1.8	2.0	6.65
11	1.3	5.65	8.3	11.1	11.7	10.25	6.1	2.6	1.85	1.8	2.0	9.85
12	4.3	5.75	8.4	11.4	11.45	10.3	5.6	2.6	1.85	1.8	2.0	6.65
13	8.2	5.85	11.2	10.75	10.75	11.1	5.45	2.55	1.85	1.8	2.0	5.65
14	9.45	8.5	10.3	10.85	10.25	10.8	5.35	2.55	1.9	1.8	2.0	5.25
15	9.35	9.9	10.85	11.1	11.55	9.75	5.6	2.5	1.9	1.8	2.0	4.15
16	18.1	9.1	10.4	11.1	10.35	9.55	5.8	2.5	1.9	1.8	2.0	4.15
17	13.4	8.35	9.6	11.15	9.45	10.5	5.9	2.45	1.9	1.8	2.0	3.3
18	24.9	10.65	9.55	11.1	9.9	9.8	4.0	2.45	1.9	1.8	2.0	3.3
19	21.7	11.4	9.4	11.15	9.4	9.6	4.2	2.4	1.9	1.8	2.0	3.05
20	14.75	11.0	11.2	11.45	9.05	9.25	4.5	2.4	1.85	1.8	2.0	2.95
21	12.2	11.05	11.3	11.4	9.4	9.75	4.5	2.35	1.8	1.8	2.0	2.85
22	10.1	11.15	11.35	11.75	8.65	8.75	4.65	2.3	1.8	1.8	2.0	3.4
23	8.9	10.9	13.0	12.05	8.65	8.7	4.8	2.3	1.8	1.8	2.0	4.05
24	8.1	10.65	17.1	11.75	8.45	7.85	4.8	2.25	1.8	[a]1.8	2.0	4.05
25	7.4	10.9	17.1	11.0	9.0	7.8	3.95	2.25	1.85	1.8	[a]2.0	10.95
26	7.0	10.55	17.95	10.6	12.1	7.7	3.1	2.2	1.8	[a]1.8	1.95	16.25
27	6.2	11.2	15.55	10.1	12.25	7.6	3.1	2.2	1.8	1.8	1.95	12.45
28	6.25	11.6	14.75	10.25	12.85	7.1	3.05	2.15	1.8	1.8	1.95	9.55
29	6.2	....	13.6	9.95	11.7	6.9	3.05	2.15	1.8	1.8	1.95	7.95
30	6.2	....	15.8	10.0	11.0	6.75	3.0	2.1	1.8	[a]1.8	1.9	7.4
31	6.0	....	17.65	....	....	....	3.0	2.1	....	1.8	....	7.2

[a] Estimated.

NOTE.—These gage heights are for the station gage, 1,000 feet upstream from the bridge gage, at which readings were made during 1905. The gage at the station was read from March 1 to July 24, 1906. From January 1 to February 28 and from September 5 to December 31 the gage at the bridge was read; these readings have been reduced to equivalent readings at the station gage. From July 25 to September 4 no readings were made and the gage heights have been estimated.

Rating table for Feather River at Oroville, C for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.75	1,200	2.00	2,060	3.30	3,260	5.20	5,300	11.00	17,600
.80	1,230	2.10	2,140	3.40	3,360	5.40	5,540	12.00	21,500
.90	1,295	2.20	2,220	3.50	3,460	5.60	5,780	13.00	26,000
1.00	1,360	2.30	2,310	3.60	3,560	5.80	6,020	14.00	31,000
1.10	1,430	2.40	2,400	3.70	3,660	6.00	6,260	15.00	36,500
1.20	1,500	2.50	2,490	3.80	3,760	6.20	6,520	16.00	42,000
1.30	1,570	2.60	2,580	3.90	3,860	6.40	6,780	17.00	47,500
1.40	1,640	2.70	2,670	4.00	3,960	6.60	7,050	18.00	53,500
1.50	1,710	2.80	2,760	4.20	4,180	6.80	7,330	19.00	59,500
1.60	1,780	2.90	2,860	4.40	4,400	7.00	7,640	20.00	65,500
1.70	1,850	3.00	2,960	4.60	4,620	8.00	9,450	21.00	71,700
1.80	1,920	3.10	3,060	4.80	4,840	9.00	11,600		
1.90	1,990	3.20	3,160	5.00	5,060	10.00	14,260		

NOTE.—This table is based on discharge measurements made during 1904-1906, and is well defined below gage height 17 feet.

Monthly discharge of Feather River at Oroville, Cal., for 1906.

[Drainage area, 3,640 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	96,300	1,240	14,500	892,000	3.98	4.59
February	19,900	4,730	11,100	616,000	3.05	3.18
March	53,200	9,640	21,600	1,330,000	5.93	6.84
April	34,800	14,100	19,200	1,140,000	5.27	5.88
May	25,300	10,300	17,500	1,080,000	4.81	5.54
June	26,000	7,260	13,800	821,000	3.79	4.23
July	7,330	2,960	5,240	322,000	1.44	1.66
August	2,910	2,140	2,490	153,000	.684	.79
September	2,100	1,920	1,970	117,000	.541	.60
October	1,920	1,920	1,920	118,000	.527	.61
November	7,560	1,920	2,410	143,000	.662	.74
December	43,400	1,990	7,070	435,000	1.94	2.24
The year	96,300	1,240	9,900	7,170,000	2.72	36.90

NOTE.—Values are rated as follows: January to June, and September, good; remainder of 1906 fair, as gage heights may be liable to error.

GRIZZLY CREEK NEAR BECKWITH, CAL.

Grizzly Creek is tributary to the Middle Fork of Feather River from the north, and has a small drainage basin. There is a reservoir site in this basin which has already been surveyed by the Reclamation Service, and gagings on Grizzly Creek are of utility in determining storage possibilities.

This station was established December 17, 1905. It is located at Reno camp, about 4 miles west of Beckwith and 1 mile above Willow Glen Hotel. It is about 1,500 feet below the falls, the present terminus of the Boca and Loyalton Railroad, and is reached by driving from Beckwith. The drainage area above the station is 51 square miles.

The channel is straight for about 200 feet above and below the measuring section. The current is rather sluggish at low water but swift at high stages. The right bank is high and rocky and can not be overflowed. The left bank is low and overgrown with cottonwoods near the water's edge, and may be overflowed at high water. The bed of the stream is rocky and not subject to material change.

Discharge measurements are made from a car on a cable. The cable is anchored to a pine stump on the right bank, while on the left bank it is supported by a tower and is anchored by means of a large rock buried in the ground at a depth of 4 feet. The initial point for soundings is the near side of the pine stump supporting the cable.

The gage is 2 by 4 inches vertical timber, graduated to feet and tenths, and nailed securely to a large cottonwood tree about 800 feet above cable and 200 feet below the Reno camp boarding house. The bench mark is a spike in the root of the tree to which the gage is fastened; elevation, 4 feet above the zero of the gage.

Discharge measurements of Grizzly Creek at Beckwith, Cal.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1905.					
December 17[a]	R. S. Hawley	4	1.8	0.55	3.1
1906.					
May 26	Hawley and Hardy	37	70	2.50	211
June 6	W. N. Hardy	36	61	2.30	201
June 14	do	34	41	1.70	96
June 22	do	34	39	1.48	65
June 28	do	34	32	1.30	43
July 7	do	32	24	.92	24
July 16	do	[b] 6	[b] 4.8	.42	5.1
July 25	do	[b] 2	[b] 1.6	.41	3.2
August 8	do	[b] 1.6	[b] 0.6	.22	.7
August 12	do	[b] 2.0	[b] 1.6	.40	3.2

[a] Ice 5 inches thick at the gage.

[b] Wading section.

Daily gage height, in feet, of Grizzly Creek near Beckwith, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.55	1.90	1.60	3.10			1.10	0.34	0.15
2	.55	2.10	1.60	2.80			1.10	.33	.15
3	.55	2.30	1.65	2.35			1.05	.32	.15
4	.55	1.65	1.65	2.45			1.00	.30	.15
5	.55	1.85	1.50	2.50			1.00	.26	.15
6	.55	1.85	1.50	2.50		2.30	1.00	.26	.15
7	.55	1.90	1.65	2.90		2.40	0.90	.25	.15
8	.55	2.00	1.65	3.60		1.80	0.90	.25	.15
9	.70	2.15	1.65	3.60		1.70	0.90	.25	.15
10	.70	2.10	1.65	3.85		1.70	0.80	.25	.15
11	.90	2.00	1.95	3.80		1.75	0.75	.25	.15
12	.80	2.00	2.45	3.80		1.70	0.70	.20	.20
13	1.00	1.80	2.30	3.90		1.70	0.60	.20	.20
14	1.00	1.80	2.15	4.10		1.70	0.50	.20	.25
15	.80	1.75	1.85	4.10		2.30	0.50	.20	.20
16	1.00	1.80	1.85	4.20		1.60	0.50	.20	.20
17	1.60	1.85	1.85	4.40		1.70	0.45	.20	.20
18	1.80	1.85	1.80	4.10		1.65	0.42	.20	.20
19	2.00	1.85	1.85	4.10		1.60	0.42	.30	.20
20	1.40	1.85	1.85	4.00		1.50	0.42	.20	.20
21	1.00	1.85	1.90	3.60		1.40	0.42	.15	.20
22	.70	1.75	2.15	3.60		1.40	0.42	.15	.20
23	.90	1.75	2.20	3.40		1.40	0.41	.15	.20
24	.90	1.85	2.65	3.40		1.40	0.41	.15	.20
25	1.20	1.95	2.60	3.80		1.40	0.41	.15	.25
26	1.10	1.80	2.60		2.50	1.35	0.41	.15	.25
27	1.55	1.65	2.65			1.30	0.41	.15	.25
28	1.40	1.65	2.70			1.20	0.40	.15	.25
29	1.40		2.80			1.20	0.40	.15	.25
30	1.90		2.85			1.15	0.36	.15	.25
31	2.40		3.10				0.34	.15	

Rating table for Grizzly Creek near Beckwith, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.10	0	0.90	22	1.70	87	2.50	225	3.60	489
0.20	0.5	1.00	28	1.80	98	2.60	249	3.80	537
0.30	1.6	1.10	34	1.90	110	2.70	273	4.00	585
0.40	3.2	1.20	42	2.00	124	2.80	297	4.20	633
0.50	5.5	1.30	50	2.10	141	2.90	321	4.40	681
0.60	9	1.40	58	2.20	159	3.00	345	4.60	729
0.70	13	1.50	67	2.30	179	3.20	393	4.80	777
0.80	17	1.60	77	2.40	202	3.40	441	5.00	825

NOTE.—The above table is strictly applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1906 and is well defined between gage heights 0.2 foot and 2.5 feet.

Monthly discharge of Grizzly Creek near Beckwith, Cal., for 1906.

[Drainage area, 51 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	202	7	40	2,460	0.784	0.90
February	179	82	110	6,110	2.16	2.24
March	369	67	153	9,410	3.00	3.46
April 1-25	681	190	469	23,300	9.20	8.55
June 6-30	202	38	83.6	4,150	1.64	1.52
July	34	2.2	11.9	732	.234	.27
August	2.2	0.2	0.73	45	.014	.02
September	1	0.2	0.51	30	.010	.01
The period				46,200		

NOTE.—Values are rated as fair, except January and February, which are liable to greater error on account of ice conditions.

INDIAN CREEK NEAR CRESCENT MILLS, CAL.

Indian Creek is a tributary from the east to North Fork of Feather River, entering below the Prattville station; it has a considerable drainage basin. A reservoir site has been surveyed by the Reclamation Service, and measurements are of utility in computing storage possibilities.

The station was established November 29, 1905. It is located about 1½ miles from Crescent Mills on the Greenville-Quincy road, and is most easily reached by driving from Taylorsville, a distance of 5 miles. It is 2,000 feet below the Arlington Bridge and near E. Cook's residence.

The channel is straight for 1,000 feet above and 200 feet below, and the current is very sluggish. Both banks are high and not liable to overflow. They are covered by a thick growth of brush up to the high-water line and above this by oaks and pines. The bed of the stream is composed of silt and is not liable to change materially. At low water the maximum depth is about 12 feet. Discharge measurements are made from a car on a cable. The initial point for soundings is the oak stump to which the cable is fastened on the right bank.

The gage is a vertical 2 by 6 inch timber, graduated to feet and tenths, and is in two sections. It is on the right bank about 20 feet above the cable. The lower section is about 5 feet long and is fastened to an overhanging willow; the upper section is about 10 feet in length and is fastened to a cottonwood tree. The bench mark is a spike driven in the cottonwood tree to which the high-water gage is attached; elevation, 8.00 feet above the zero of the gage.

Discharge measurements of Indian Creek at Crescent Mills, Cal., by Hawley and Hardy, in 1905–6.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
1905.	*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*	1906.	*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 14	45	66	1.35	76	July 3	180	1,570	3.32	367
					July 11	67	288	2.45	268
1906.					July 20	65	211	1.70	129
May 29	190	2,080	6.25	1,940	July 30	65	184	1.35	77
May 31	186	1,960	5.56	1,580	August 6	65	172	1.12	50
June 9	182	1,850	4.87	1,120	August 17	64	176	1.20	55
June 18	182	1,810	4.69	1,020	August 27	64	171	1.05	40
June 25	181	1,680	3.80	608	September 9	64	171	1.10	44

NOTE.—These measurements were made at different sections.

Daily gage height, in feet, of Indian Creek at Crescent Mills, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.45	3.15	5.75	8.45	6.4	5.4	3.3	1.25	1.1	1.5	1.45	1.45
2	1.5	3.0	5.15	7.35	6.5	5.4	3.3	1.15	1.1	1.5	1.45	1.45
3	1.5	3.0	5.15	6.7	6.8	5.3	3.3	1.1	1.15	1.45	1.55	1.5
4	1.5	2.95	4.95	6.3	6.95	5.5	3.25	1.1	1.15	1.45	2.2	1.5
5	1.5	2.95	4.7	5.95	7.1	5.5	3.1	1.1	1.15	1.45	2.8	1.5
6	1.5	2.95	4.45	6.0	7.0	5.35	3.0	1.1	1.15	1.45	2.35	1.5
7	1.5	2.95	4.45	6.5	6.9	5.15	2.9	1.1	1.15	1.45	2.0	1.55
8	1.45	2.95	4.6	7.0	6.8	4.95	2.8	1.4	1.15	1.45	1.85	1.75
9	1.5	2.95	5.0	7.5	6.7	4.9	2.7	1.3	1.1	1.5	1.8	1.9
10	1.5	3.0	5.3	7.7	6.75	4.9	2.6	1.2	1.1	1.5	1.7	3.5
11	1.6	3.0	5.8	7.6	6.8	4.9	2.4	1.2	1.1	1.5	1.65	3.5
12	2.3	3.0	7.8	7.3	6.8	4.95	2.3	1.15	1.15	1.5	1.65	4.2
13	2.9	3.05	8.0	7.1	6.4	4.95	2.3	1.25	1.15	1.5	1.6	3.6
14	3.95	3.4	6.9	7.1	6.2	4.8	2.2	1.35	1.15	1.5	1.6	3.3
15	2.8	3.6	6.1	7.3	6.1	4.7	2.2	1.25	1.2	1.5	1.6	3.0
16	7.1	4.6	5.6	7.5	5.8	4.75	2.0	1.2	1.25	1.5	1.7	2.8
17	7.1	4.3	5.3	7.7	5.4	4.8	1.9	1.2	1.25	1.5	1.75	2.65
18	9.22	4.35	5.0	7.6	5.1	4.65	1.9	1.2	1.25	1.5	1.7	2.55
19	10.68	5.1	4.7	7.5	4.9	4.5	1.8	1.15	1.25	1.5	1.6	2.45
20	7.5	5.5	4.6	7.6	4.9	4.4	1.7	1.15	1.2	1.5	1.6	2.4
21	5.45	6.1	4.9	7.7	4.8	4.35	1.6	1.05	1.15	1.5	1.6	2.35
22	4.5	5.7	5.9	7.8	4.7	4.25	1.55	1.05	1.15	1.5	1.6	2.35
23	4.15	5.2	6.95	7.65	4.6	4.0	1.5	1.05	1.15	1.5	1.6	2.5
24	3.8	4.9	8.1	7.25	4.5	3.85	1.5	1.05	1.2	1.5	1.55	2.75
25	3.45	4.65	8.85	6.8	4.5	3.8	1.5	1.1	1.25	1.5	1.55	4.6
26	3.4	4.5	8.9	6.35	5.1	3.75	1.45	1.2	1.3	1.45	1.55	6.9
27	3.3	5.5	8.58	6.1	5.75	3.7	1.45	1.2	1.3	1.45	1.5	6.85
28	3.3	6.6	7.85	6.1	6.25	3.6	1.4	1.05	1.35	1.45	1.5	5.4
29	3.3	....	7.35	6.15	6.15	3.5	1.35	1.05	1.4	1.45	1.5	4.6
30	3.2	....	7.25	6.3	5.75	3.4	1.35	1.1	1.4	1.4	1.5	4.1
31	3.1	....	8.58	....	5.55	....	1.35	1.1	....	1.4	....	4.2

Rating table for Indian Creek at Crescent Mills, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	35	2.00	182	3.00	395	4.00	700	6.00	1,800
1.10	46	2.10	200	3.10	421	4.20	785	6.20	1,940
1.20	58	2.20	219	3.20	448	4.40	880	6.40	2,080
1.30	71	2.30	238	3.30	475	4.60	980	6.60	2,220
1.40	84	2.40	258	3.40	502	4.80	1,080	6.80	2,360
1.50	98	2.50	278	3.50	530	5.00	1,180	7.00	2,500
1.60	113	2.60	299	3.60	560	5.20	1.300	8.00	3,200
1.70	129	2.70	321	3.70	595	5.40	1,420	9.00	3,900
1.80	146	2.80	345	3.80	630	5.60	1,540	10.00	4,600
1.90	164	2.90	369	3.90	665	5.80	1,660	11.00	5,300

NOTE.—This table is based on 14 discharge measurements made during 1905-6, and is well defined below gage height 6.2 feet.

Monthly discharge of Indian Creek at Crescent Mills, Cal., for 1906.

[Drainage area, 740 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	5,080	91	868	53,400	1.17	1.35
February	2,220	382	824	45,800	1.11	1.16
March	3,830	905	2.000	123,000	2.70	3.11
April	3,520	1,760	2,550	152.000	3.45	3.85
May	2.570	930	1.790	110.000	2.42	2.79
June	1.480	502	1,010	60,100	1.36	1.52
July	475	78	226	13,900	0.305	0.35
August	84	40	53.1	3,260	0.072	.08
September	84	46	57.9	3,450	0.078	.09
October	98	84	94.8	5,830	0.128	.15
November	345	91	132	7,850	0.178	.20
December	2,430	91	534	32,800	0.722	.83
The year	5.080	40	845	611,000	1.14	15.48

NOTE.—These values are excellent.

NORTH FORK OF FEATHER RIVER BELOW PRATTVILLE, CAL.

This station was established November 22, 1905. Previous to that date, however, the Great Western Power Company had installed a gage rod and maintained a daily record since June 13, 1905, making gagings by means of a boat. This station is located in the canyon at the proposed dam site of the Great Western Power Company, about 3 miles below the Meadow View bridge crossing on the Prattville-Greenville road, and about 5 miles southeast of Prattville. The drainage area above this point is only 506 square miles, but the run-off during the months of low flow is about half the total run-off at the Oroville station from a drainage area of 3,640 square miles.

The equipment for gaging at this station consists of a ⅝-inch cable anchored to a large rock on the left bank and to a spruce tree on the right, having a clear span of 155 feet and supporting a car with a lock box. Parallel to the cable and 35 feet upstream a guy wire spans the channel for staying the meter in the higher stages. The cable is marked with a ring of white paint every 5 feet for convenience in sounding, and the initial point is an iron bolt in the root of the tree supporting the cable. The car is used for making measurements at all stages. The gage rod is inclosed in the clock register well, which is on the right bank about 700 feet above the cable. The well, which protects the gage from the thin surface ice in winter, is lined on the inside with building paper to prevent freezing and is provided with a hinged door on the river side to permit easy access for reading direct and comparison with clock register. The reference bench mark is a point surrounded by a ring of white paint on a rock 8 feet southwest of the gage; elevation, 7.62 feet above the zero of the gage.

The channel is straight for 400 feet above the cable and for 200 feet below. The bed is rocky and not liable to change materially. Both banks are high and steep and not subject to overflow at any stage. There is a growth of small willows along the water's edge and for a short distance back of it, while higher up are found spruce and fir trees. The stream is in one channel at all stages and is swift in high water, but has moderate velocity at other times. The cross section is regular and not subject to much change, the width of the stream being about 60 feet at low water with a maximum depth of 9 feet.

This station is maintained in cooperation with the Great Western Power Company, whose hydrographer, Mr. L. J. Bevan, has kept the gage-height record and made meter measurements since it was established in 1905. The data collected at this point indicates the quantity of water that could be impounded in the proposed Big Meadows reservoir, and the water thus stored would be available for power and irrigation and could be utilized in the control of Sacramento River.

Discharge measurements of North Fork of Feather River below Prattville, Cal., in 1905–6.

Date.	Hydrographer.	Gage height.	Discharge.	Date.	Hydrographer.	Gage height.	Discharge.
1905.		*Feet.*	*Sec.-ft.*	1906.		*Feet.*	*Sec.-ft.*
June 13	R. W. Armstrong	3.45	1,256	June 2[a]	L. J. Bevan	5.17	2,074
June 21	W. E. Spear	3.00	1,061	June 2	do	5.17	2,172
July 1	do	2.58	869	June 11	W. V. Hardy	5.55	2,445
July 10	R. W. Armstrong	2.40	761	June 19[a]	L. J. Bevan	5.73	2,382
July 17	W. E. Spear	2.32	739	June 19	do	5.73	2,571
August 10	do	2.10	668	June 23[a]	do	4.82	1,924
August 14	L. J. Bevan	2.11	663	June 23	W. V. Hardy	4.82	1,831
August 26	do	2.05	649	July 2	do	4.26	1,517
October 18	do	2.01	621	July 3	L. J. Bevan	4.21	1,607
November 25	do	1.96	602	July 9	do	3.83	1,306
Do	Hawley & Bevan	1.96	601	July 12	W. V. Hardy	3.53	1,200
				July 21	do	3.05	1,016
1906.				July 24	L. J. Bevan	2.93	1,023
January 20	L. J. Bevan	4.19	1,514	July 31	W. V. Hardy	2.75	933
January 24	do	3.12	1,057	August 3	L. J. Bevan	2.71	870
February 22	do	4.26	1,600	August 4	W. V. Hardy	2.65	908
March 7	do	2.97	1,007	August 16	do	2.50	826
March 26	do	6.50	2,852	August 29	do	2.25	787
April 11	do	5.47	2,125	September 6	do	2.15	741
May 5	do	6.87	3,137	September 19	L. J. Bevan	2.25	700
May 30	Hardy & Hawley	5.80	2,539	October 21	do	2.13	692

[a] 45-pound boiler weight used as anchor for meter.

Daily gage height, in feet, of North Fork of Feather River below Prattville, Cal., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1	......	......	......	......	......	......	2.59	......	2.06	2.02	......	2.15
2	......	......	......	......	......	......	2.57	2.16	......	2.01	......	......
3	......	......	......	......	......	......	2.55	......	2.04	2.00	......	......
4	......	......	......	......	......	......	2.53	2.17	......	......	1.98	......
5	......	......	......	......	......	......	2.48	2.17	......	2.00	1.98	1.85
6	......	......	......	......	......	......	2.50	2.16	......	2.00	......	......
7	......	......	......	......	......	......	2.49	2.17	2.04	2.04	......	......
8	......	......	......	......	......	......	2.43	2.14	2.04	2.03	......	......
9	......	......	......	......	......	......	2.42	2.14	2.05	2.02	......	......
10	......	......	......	......	......	......	2.42	2.09	2.03	......	......	......
11	......	......	......	......	......	......	2.39	2.11	2.03	2.01	......	......
12	......	......	......	......	......	......	2.40	2.16	2.04	2.01	......	1.83
13	......	......	......	......	......	3.45	2.39	......	2.04	2.01	......	......
14	......	......	......	......	......	......	2.38	2.11	2.05	2.01	......	1.93
15	......	......	......	......	......	......	2.39	2.11	2.04	2.01	......	......
16	......	......	......	......	......	......	2.34	2.12	2.05	2.01	1.99	2.01
17	......	......	......	......	......	......	2.33	2.11	2.03	2.01	......	......
18	......	......	......	......	......	3.17	......	2.10	2.03	......	......	......
19	......	......	......	......	......	3.05	2.32	2.10	2.03	......	1.99	......
20	......	......	......	......	......	3.01	2.31	2.00	2.01	......	......	......
21	......	......	......	......	......	3.01	2.32	2.11	2.01	......	1.98	1.81
22	......	......	......	......	......	2.90	2.28	2.14	2.00	......	1.96	......
23	......	......	......	......	......	2.87	2.28	2.14	1.99	......	1.98	1.84
24	......	......	......	......	......	2.83	2.33	2.14	2.01	......	1.97	......
25	......	......	......	......	......	2.78	2.29	2.11	2.01	......	1.97	1.91
26	......	......	......	......	......	2.77	2.26	2.06	2.00	......	......	......
27	......	......	......	......	......	2.69	2.24	2.08	2.02	......	......	......
28	......	......	......	......	......	2.66	2.22	2.07	2.16	......	2.01	......
29	......	......	......	......	......	2.61	2.23	2.06	2.11	2.00	......	......
30	......	......	......	......	......	2.58	2.22	2.05	2.06	......	......	2.00
31	......	......	......	......	......	......	2.21	2.06	......	......	......	......
1906.												
1	......	......	3.60	5.95	5.85	5.30	4.22	2.76	2.17	2.17	2.13	1.99
2	......	......	3.45	5.15	6.05	5.19	4.23	2.72		2.17	2.15	2.00
3	1.91	2.98	3.35	4.70	6.23	5.29	4.22	2.68		2.16	2.25	2.01
4	......	......	3.15	4.50	6.60	5.58	4.18	2.66		2.16	2.62	2.01
5	......	......	3.12	4.40	6.93	6.00	4.14	2.63		2.16	2.88	2.02
6	1.93	2.91	3.05	4.45	7.10	5.92	4.04	2.63	......	2.16	2.65	2.05
7	1.92	2.87	3.01	4.60	7.20	5.59	3.98	2.62	......	2.16	2.42	2.07
8	1.90	2.85	3.00	4.77	7.18	5.25	3.92	2.60	2.10	2.16	2.30	2.17
9	1.94	2.86	3.08	5.08	7.17	5.18	3.83	2.58	......	2.15	2.24	2.25
10	1.94	2.90	3.24	5.46	7.27	5.37	3.73	2.56	......	2.15	2.20	2.44
11	2.03	2.97	3.75	5.45	7.56	5.65	3.60	2.57	......	2.15	2.18	2.18
12	2.11	3.07	4.35	5.38	7.68	5.60	3.52	2.50	......	2.15	2.17	2.10
13	2.15	3.11	......	5.12	7.15	5.52	3.50	2.56	2.08	2.15	2.16	2.18
14	2.35	3.58	......	5.05	6.73	5.40	3.47	2.53	......	......	2.15	2.24
15	2.20	3.85	......	5.10	6.80	5.33	3.43	2.51	2.20	......	2.16	2.29
16	2.80	3.79	......	5.19	6.65	5.60	3.45	2.50	......	......	2.24	2.35
17	3.12	3.68	3.60	5.36	6.05	6.28	3.28	2.47	......	......	2.21	2.44
18	4.25	4.00	3.45	5.48	6.16	6.05	3.24	2.47	......	......	2.16	2.33
19	4.65	4.27	3.33	5.50	5.50	5.73	3.20	......	......	......	2.10	2.33
20	4.30	4.31	3.30	5.58	5.45	5.58	3.13	......	2.25	2.13	2.10	2.33
21	3.80	4.28	3.90	5.88	5.45	5.50	3.08	......	2.22	2.13	2.11	2.31
22	3.54	4.15	4.65	6.18	5.40	5.40	3.01	......	2.20	2.13	2.10	2.30
23	3.32	3.74	5.15	6.40	5.32	5.20	2.96	......	2.21	2.13	2.02	2.38
24	3.28	3.70	5.85	6.35	5.18	5.02	2.94	......	2.23	2.13	2.04	2.48
25	3.13	3.62	6.30	6.00	5.27	4.86	2.90	2.25	2.22	2.13	2.05	3.42
26	3.17	3.45	6.47	5.65	5.90	4.80	2.87	......	2.20	2.12	2.04	4.40
27	3.32	3.65	5.90	5.50	6.36	4.68	2.84	......	2.19	2.11	2.02	4.57
28	......	3.80	5.25	5.60	6.33	4.52	2.83	......	2.19	2.11	2.01	4.65
29	......	......	4.80	5.55	6.17	4.35	2.80	......	2.18	2.10	1.97	4.35
30	......	......	5.15	5.69	5.78	4.25	2.78	......	2.17	2.10	2.01	3.95
31	......	......	6.35	......	5.48	......	2.76	......	......	2.13	......	3.60

Rating table for North Fork of Feather River below Prattville, Cal., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	570	2.50	805	3.20	1.090	3.90	1,410	4.60	1,770
1.90	600	2.60	845	3.30	1,135	4.00	1,460	4.70	1,825
2.00	630	2.70	885	3.40	1,180	4.10	1,510	4.80	1,880
2.10	665	2.80	925	3.50	1,225	4.20	1,560	4.90	1,935
2.20	700	2.90	965	3.60	1,270	4.30	1,610	5.00	1,990
2.30	735	3.00	1,005	3.70	1,315	4.40	1,660	5.10	2,045
2.40	770	3.10	1,045	3.80	1,360	4.50	1,715	5.20	2,100

NOTE.—This table is based on 40 discharge measurements made during 1905-6 and is well defined. Above gage height 5.2 feet the rating curve is a tangent, the difference being 60 per tenth.

Monthly discharge of North Fork of Feather River below Prattville, Cal., for 1905–6.

[Drainage area, 506 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
July	845	700	761	46,800	1.50	1.73
August	700	647	670	42,000	1.32	1.52
September	682	630	644	38,300	1.27	1.46
October	647	630	631	38,800	1.25	1.44
November	630	615	628	37,400	1.24	1.43
December	682	570	607	37,300	1.20	1.38
The period	845	570	657	241,000	1.30	8.96
1906.						
January	1,800	600	937	57,600	1.85	2.13
February	1,610	945	1,210	67,200	2.39	2.49
March	2,850	1,000	1,590	97,800	3.14	3.62
April	2,820	1,660	2,210	132,000	4.37	4.88
May	3,600	2,100	2,770	170,000	5.47	6.31
June	2,760	1,580	2,190	130,000	4.33	4.83
July	1,580	905	1,200	73,800	2.37	2.73
August	905	700	795	48,900	1.57	1.81
September	717	665	688	40,900	1.36	1.52
October	682	665	679	41,800	1.34	1.54
November	965	615	698	41,500	1.38	1.54
December	1,800	630	894	55,000	1.77	2.04
The year	3,600	600	1,320	956,000	2.61	35.44

NOTE.—Discharge estimated on days when gage heights are missing. Values are excellent.

NORTH FORK OF FEATHER RIVER ABOVE PRATTVILLE.

This station was established June 12, 1905. It is 3 miles east of Prattville and about ¼ mile above the junction with Hamilton Branch. The drainage area above the station is 245 square miles.

The channel of the stream is straight for 200 feet above and 300 feet below the measuring section and has a shale bottom subject to slight change. Gagings are made from a boat. The section is about 65 feet wide and 5 feet deep at low water; at very high water there is a diversion overflow around the station, leaving the main stream about 1½ miles above the point of measurement.

The gage is nailed to a willow stump 15 feet above the measuring section. Up to October 15, during 1905, the gage was read daily; after this date, weekly.

Discharge measurements of North Fork of Feather River above Prattville, Cal., in 1905–6.

Date.	Hydrographer.	Gage height.	Discharge.
1905.		*Feet.*	*Sec.-ft.*
June 12	R. W. Armstrong	2.33	890
June 22	W. E. Spear	1.79	620
July 1	do	1.48	520
July 15	R. W. Armstrong	1.23	407
July 28	W. E. Spear	1.09	399
August 15	L. J. Bevan	.99	370
September 4	do	.90	345
December 17	do	.80	330
1906.			
February 28	L. J. Bevan	1.82	669
April 12	do	2.77	1,046
May 15	do	3.83	1,524
July 7	do	2.48	929
August 8	do	1.34	502

Daily gage height, in feet, of North Fork of Feather River above Prattville, Cal., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1							1.50	1.05	0.90	0.88		
2							1.48	1.06	.91	.85		
3							1.47		.90	.84		
4							1.46	1.05	.90	.84	0.82	
5							1.39	1.05	.90	.85		
6							1.40	1.04		.85		
7							1.35	1.02	.88	.90		
8							1.33	1.01	.87	.90		
9							1.32	1.02	.90	.88		
10							1.31	1.01	.90			
11							1.29	1.00	.87	.87		
12							1.27	0.99	.86	.87		0.75
13							1.26	.99	.86	.86		
14							1.24	.99	.89	.86		
15							1.23	.99	.89	.87		
16							1.22	.97	.90	.86	0.83	
17						2.08	1.20	.95	.88			0.80
18								.95	.87			
19						1.97	1.18	.94	.86		0.82	
20						1.90	1.18	.94	.85			
21						1.86	1.16	.95	.84			0.81
22						1.80	1.15	.97	.82			
23						1.78	1.14	.96	.82			
24						1.76	1.16	.98	.84			
25						1.69	1.15	.95	.85			
26						1.67	1.14	.90	.84			
27						1.59	1.14	.94	.87			
28						1.55	1.09	.92	.90		0.87	
29						1.53	1.10	.91	.95	0.85		
30						1.51	1.07	.90	.90			0.87
31							1.06	.90				
1906.												
1									1.12			
2												
3						2.83					1.00	
4								1.40				
5					3.92							
6	0.76	1.19										
7				2.51			2.48			0.90		
8								1.34	1.04			0.94
9												
10												
11								1.34			0.95	
12					4.15							
13	0.88											
14				2.60			2.06			0.89		
15					3.83				1.06			0.95

Daily gage height, in feet, of North Fork of Feather River above Prattville, Cal., for 1905-6—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906												
16						3.30						
17		1.55	1.55								0.98	
18								1.20				
19	1.68				2.90							
20									0.96			
21							1.80			0.88		
22									0.96			3.97
23						3.32						
24		1.55	2.59								0.96	
25								1.18				
26												
27												
28		1.82					1.48			0.86		
29					3.18				0.94			2.54
30						2.57						
31			2.04									

HAMILTON BRANCH NEAR PRATTVILLE, CAL.

This station was established June 12, 1905. It is located about 3 miles east of Prattville and 1¼ miles above the junction of Hamilton Branch and North Fork. The drainage area above the station is 230 square miles.

The channel is straight for 200 feet above and below the measuring section and has a shale bottom subject to a very slight change.

Discharge measurements are made from a boat at a section about 70 feet wide and 4 feet deep at low water. The stream never overflows.

The gage is in two parts, nailed to posts driven into the stream bed near a clump of willows. Up to October 15, during 1905, the gage was read daily; after that date, weekly.

Discharge measurements of Hamilton Branch near Prattville, Cal., in 1905-6.

Date.	Hydrographer.	Gage height.	Discharge.
1905.		*Feet.*	*Sec.-ft.*
June 12	R. W. Armstrong	3.08	394
June 23	W. E. Spear	2.74	243
July 3	do	2.62	215
July 28	do	2.56	209
August 15	L. J. Bevan	2.56	211
September 4	do	2.55	210
December 17	do	2.40	177
1906.			
January 19	L J. Bevan	3.60	567
February 28	do	3.92	745
April 12	do	4.43	1,017
May 15	do	5.21	1,494
July 7	do	3.19	439
August 8	do	2.77	294

Daily gage height, in feet, of Hamilton Branch near Prattville, Cal., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1							2.66	2.56	2.55	2.54		
2							2.64	2.56	2.55	2.53		
3							2.64		2.55	2.53		
4							2.63	2.56	2.55	2.50	2.47	
5							2.62	2.55	2.55	2.48		
6							2.63	2.56		2.48		
7							2.61	2.56	2.54	2.50		
8							2.60	2.55	2.54	2.50		
9							2.59	2.56	2.54	2.50		
10							2.59	2.56	2.54			
11							2.58	2.55	2.53	2.49		
12							2.58	2.56	2.53	2.49		2.40
13							2.58	2.56	2.53	2.49		
14							2.57	2.55	2.53	2.48		
15							2.57	2.56	2.53	2.49		
16							2.58	2.57	2.53	2.48	2.46	
17						2.91	2.58	2.56	2.53			2.40
18								2.57	2.53			
19						2.84	2.58	2.58	2.53			
20						2.82	2.58	2.57	2.52		2.45	
21						2.80	2.60	2.58	2.52			2.40
22						2.76	2.58	2.59	2.52			
23						2.74	2.59	2.58	2.52			
24						2.72	2.62	2.58	2.52			
25						2.70	2.61	2.56	2.52			
26						2.70	2.60	2.56	2.52			
27						2.67	2.60	2.57	2.50			
28						2.67	2.57	2.56	2.54		2.44	
29						2.65	2.56	2.55	2.54	2.48		
30						2.62	2.56	2.55	2.52			2.44
31							2.56	2.56				
1906.												
1							3.42		2.68			
2					4.62	4.22						
3											2.62	
4								2.75				
5					5.17							
6	2.30	3.22										
7				3.87			3.20			2.58		
8								2.77	2.65			2.59
9												
10												
11								2.76			2.57	
12					5.75							
13												
14				4.30			3.00			2.57		
15					5.21				2.69			2.60
16	2.81					4.18						
17		3.71	3.57								2.60	
18								2.71				
19	3.60				4.45							
20									2.61			
21							2.85			2.58		
22									2.60			2.72
23						4.00						
24		3.93	4.88								2.60	
25								2.68				
26												
27										2.51		
28		3.92					2.78					
29					4.95				2.59			4.13
30						3.50						
31			5.18									

BUTT CREEK AT BUTTE VALLEY, CAL.

Butt Creek rises in the extreme western part of Plumas County and flows eastward, discharging into North Fork of Feather River about 9 miles south of Prattville.

This station was established June 14, 1905, about 2 miles above the mouth of the river, and 100 feet below the footbridge at the lower end of Butte Valley. The drainage area above the station is 73 square miles.

The measuring section is 20 feet wide and 2 feet deep at low water, when measurements are made by wading; in high stages measurements are made from the footbridge. The bottom of the channel is composed of coarse gravel and is not subject to much change.

The gage rod is nailed to a post in a clump of willows 15 feet below the measuring section. During 1905 and until July, 1906, the gage was read daily by B. F. Barbee. Since July, 1906, W. W. Savercool has made readings whenever there was any material change of stage.

Discharge measurements of Butt Creek at Butte Valley, Cal., in 1905–6.

Date.	Hydrographer.	Gage height.	Discharge.
1905.		*Feet.*	*Sec.-ft.*
June 14	R. W. Armstrong	2.84	76
July 18	do	2.51	42
August 19	do	2.39	35
September 9	W. E. Spear	2.38	30
1906.			
March 2	L. J. Bevan	3.16	136
March 27	do	4.54	365
April 10	do	4.75	426
June 21	do	3.54	179
July 24	do	2.68	57
August 30	W. V. Hardy		42

NOTE.—About 5 second-feet are diverted 6 miles above this station from Butt Creek into Yellow Creek watershed.

Daily gage height, in feet, of Butt Creek at Butte Valley, Cal., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1											2.38	2.55
2											2.38	2.63
3											2.38	2.63
4											2.38	2.61
5											2.38	2.65
6										2.38	2.38	2.65
7										2.38	2.38	2.64
8											2.38	2.63
9									2.38	2.37	2.38	2.65
10										2.37	2.38	2.74
11										2.38	2.38	2.77
12										2.38	2.38	2.69
13										2.38	2.38	2.76
14						2.84				2.38	2.38	2.77
15										2.38	2.38	2.77
16										2.38	2.38	2.72
17										2.38	2.38	2.59
18							2.51			2.38	2.38	2.51
19								2.39		2.38	2.38	2.51
20										2.38	2.45	2.59

Daily gage height, in feet, of Butt Creek at Butte Valley, Cal., for 1905–6—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
21										2.38	2.42	2.76
22										2.38	2.42	2.76
23										2.38	2.44	2.73
24										2.38	2.43	2.73
25										2.38	2.43	2.73
26										2.38	2.43	2.76
27										2.38	2.44	2.71
28										2.38	2.43	2.68
29										2.38	2.43	2.68
30										2.38	2.45	2.67
31										2.38		2.78
1906.												
1	2.85	2.70	3.42	5.15	4.30	3.94	3.06	2.61	2.57			
2	2.88	2.68	3.31	4.50	4.33	3.99	3.13	2.61				
3	2.91	2.68	3.28	4.17	4.53	4.02	3.02	2.61				
4	2.94	2.68	3.25	4.02	4.65	4.42	2.98	2.60				
5	2.96	2.69	3.17	3.96	4.80	4.20	2.93	2.59			2.93	
6	2.99	2.69	3.15	4.06	4.72	4.22	2.90	2.59		2.54		
7	3.03	2.69	3.16	4.30	4.78	4.24	2.89	2.59			2.65	
8	3.03	2.71	3.24	4.38	4.70	3.87	2.87	2.59	2.57			2.43
9	3.07	2.71	3.34	4.70	4.72	3.83	2.83	2.59				
10	3.10	2.94	3.46	4.72	4.76	3.83	2.81	2.58			2.61	2.63
11	2.76	2.95	3.73	4.35	4.65	3.79	2.79	2.60				2.67
12	2.83	2.95	5.75	4.45	4.48	3.92	2.77	2.61				3.13
13	2.85	2.97	5.15	4.42	4.33	3.75	2.80	2.61	2.63	2.55		3.13
14	2.93	3.25	4.30	4.41	4.34	3.68	2.78	2.61	2.61			3.13
15	2.98	3.65	4.02	4.58	4.37	3.65	2.77		2.62			3.10
16	4.66	3.30	3.78	4.70	4.00	4.18	2.75					3.10
17	5.14	3.24	3.47	4.57	3.83	3.87	2.74				2.58	3.11
18	7.69	3.60	3.35	4.53	3.70	3.71	2.74					2.68
19	6.72	4.09	3.27	4.56	3.72	3.64	2.72					2.63
20	5.45	3.75	3.27	4.73	3.70	3.39	2.72			2.55		2.63
21	5.15	3.95	3.42	4.88	3.71	3.55	2.71					2.61
22	5.53	3.65	4.22	4.87	3.68	3.47	2.71		2.59			2.60
23	3.16	3.55	4.40	4.63	3.67	3.40	2.69					2.67
24	3.00	3.42	4.90	4.43	3.68	3.33	2.69					2.72
25	2.90	3.35	4.90	4.25	3.84	3.30	2.68	2.60				3.28
26	2.82	3.30	4.56	4.13	4.55	3.27	2.68					4.43
27	2.81	4.09	5.54	4.12	4.50	3.22	2.67			2.55		4.33
28	2.75	4.10	4.20	4.22	4.38	3.21	2.66					3.42
29	2.72		4.10	4.20	4.20	3.12	2.64		2.56		2.45	3.10
30	2.70		5.00	4.28	4.10	3.09	2.62					
31	2.70		6.00		3.97		2.61					

NORTH FORK OF FEATHER RIVER NEAR BIG BEND, CAL.

This station was established June 13, 1905. It is located 300 feet above the head of the Big Bend tunnel, about 20 miles north of Oroville. The drainage area at this point is 1,940 square miles.

The channel is straight for 500 feet above and below the station, and is in rock, with little probability of change. A low-water gage graduated from 0.0 to 7.5 feet is bolted into rock on the west bank 10 feet below the measuring section, and a high-water gage graduated from 7 to 22 feet is nailed to a poplar tree on the west bank 100 feet above the measuring section. The zero of the gage is 870.22 feet above sea level and 7.89 feet below the reference bench mark, which is a knob on the top of the rock to which the low-water gage is fastened.

Discharge measurements are made by means of a boat when the gage is below 11 feet, and for higher stages float measurements only are made at this point, while check measurements are made 2 miles downstream from the cable of the Golden State Power Company. At low water the stream at the station is about 85 feet wide and 19 feet deep, with a uniform but sluggish current. During 1905 and 1906 the gage was read every other day by Henry Turner.

Discharge measurements of North Fork of Feather River near Big Bend, Cal., by Spear and Bevan, in 1905–6.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
1905.	*Feet.*	*Sec.-ft.*	1906.	*Feet.*	*Sec.-ft.*
June 13	4.15	3,750	March 13	12.25	13,230
July 13	2.75	1,352	April 18	10.24	9,962
August 20	2.14	1,048	April 28	8.98	8,052
September 16	2.07	1,003	June 6	9.55	8,655
October 22	2.15	1,038	June 7	9.08	8,332
December 5	2.25	1,101	July 13	4.73	3,081
			August 12	3.03	1,677
1906.			October 11	2.44	1,269
February 2	4.79	3,017			

Daily gage height, in feet, of North Fork of Feather River near Big Bend, Cal., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1											2.17	2.32
2								2.26	2.06	2.18		
3										2.15	2.17	2.27
4								2.06	2.06	2.10		2.31
5										2.08	2.17	2.25
6								2.24	2.07			2.27
7										2.10	2.18	2.25
8								2.21	2.06			
9									2.06	2.12		2.21
10								2.17				
11									2.05	2.11	2.17	2.11
12								2.16				
13							2.75	2.16	2.05	2.13	2.18	2.18
14												2.22
15							2.66	2.17	2.08	2.12	2.17	
16									2.07			2.26
17							2.62	2.15		2.11	2.18	2.27
18									2.06			
19							2.60	2.13		2.10	2.18	2.66
20								2.10	2.06	2.12		
21							2.55	2.13			2.27	2.44
22										2.15	2.37	2.36
23							2.50	2.20			2.19	
24												2.24
25							2.46	2.14	2.05	2.18	2.18	
26								2.11				2.29
27							2.35		2.07	2.20	2.57	2.36
28								2.07				
29							2.34		2.35	2.19	2.37	2.26
30								2.06	2.25	2.18		
31							2.28					
1906.												
1	2.24					10.65		3.25	2.62			2.45
2		4.80	7.65	11.80	9.85	8.95	6.25	3.20			2.40	
3	2.24								2.58		3.02	2.80
4		4.65	7.30	9.55	10.60		6.23	3.12	2.58		5.90	
5	2.30					11.20					4.60	2.80
6	2.31	4.54	6.58	8.70	11.20	9.55	5.85	3.08	2.58			
7			6.50			9.15			2.58		3.40	2.80
8	2.35	4.50		9.60	11.25		5.50	3.00				
9			6.46			9.05			2.55		3.00	3.20
10	2.30	4.65		10.70	11.85		5.25	2.97	2.53			

Daily gage height, in feet, of North Fork of Feather River near Big Bend, Cal., for 1905–6—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
11			7.35			9.00				2.44	2.80	6.20
12	2.96	4.79	13.45	9.85	11.20		4.85	3.03	2.52			
13		4.81	12.25			8.90	4.73	3.01			2.75	5.10
14	2.46		10.06	9.75	10.05	8.75	4.60		2.60	2.44		
15		8.15	8.85					2.90			2.75	3.10
16	13.23			10.30	9.40	9.30	4.38		2.58			
17		6.51	7.85								2.83	3.80
18	18.48			10.25	8.85	8.85	4.22	2.85	2.58			
19	19.90	7.75	6.74	10.22					2.56		2.73	3.60
20	12.22	8.20			8.40	8.40	3.90	2.78	2.55			
21			7.54	10.85					2.53		2.67	3.50
22	7.15	8.97	10.35		8.00	7.90	3.68					
23				11.10				2.75			2.65	3.80
24	5.88	8.10	14.00		7.50	7.30	3.60	2.73				
25				10.65							2.60	8.80
26	5.56	8.75	14.70		7.90	6.95	3.53	2.66				15.40
27				9.35	8.40						2.55	13.00
28	5.25	9.80	12.10	9.00	11.05	6.68	3.45					9.55
29					10.45					2.40	2.50	
30	5.10		12.34	8.40		6.39	3.35	2.65				
31	4.88				9.35							

MISCELLANEOUS MEASUREMENTS IN FEATHER RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made in Feather River drainage basin during 1905 and 1906:

Bailey Creek near Prattville, Cal.—This stream is a tributary of North Fork of Feather River. The following measurements were made a short distance above its mouth.

1905—July 31: Discharge, 2.6 second-feet.
1906—May 23: Discharge, 50 second-feet.
    September 5: Discharge, 3.3 second-feet.

Berry Creek near Berrycreek post-office, Cal.—This creek is a small tributary of the North Fork of Feather River. A measurement was made September 11, 1906, at wagon bridge at Berrycreek post-office:

Width, 20 feet; area, 27 square feet; discharge, 8 second-feet.

Big Springs near Prattville, Cal.—These springs discharge into Hamilton Branch of North Fork of Feather River. The following measurements were made above its mouth:

1905—June 13: Discharge, 56 second-feet.
    July 5: Discharge, 65 second-feet.
    August 8: Discharge, 69 second-feet.
    September 1: Discharge, 50 second-feet.
    December 16: Discharge, 61 second-feet.
1906—June 1: Discharge, 150 second-feet.
    July 6: Discharge, 56 second-feet.
    August 7: Discharge, 61 second-feet.

Butt Creek near Prattville, Cal.—This stream is a tributary of North Fork of Feather River. The following measurements were made at the bridge on Prattville-Sterling road:

1905—July 11: Discharge, 21 second-feet.
1906—March 27: Discharge, 156 second-feet.
June 21: Discharge, 142 second-feet.
July 20: Discharge 54 second-feet.

Clear Creek near Prattville, Cal.—This stream is a tributary of Hamilton Branch of North Fork of Feather River. The following measurements were made in 1905 a short distance above its mouth:

July 5: Discharge, 29 second-feet.
August 8: Discharge, 28 second-feet.
September 1: Discharge, 27 second-feet.

Chester Branch of North Fork of Feather River near Prattville, Cal.—The following measurements were made at the wagon bridge at Chester, Cal.:

1905—July 7: Discharge, 35 second-feet.
August 5: Discharge, 23 second-feet.
August 31: Discharge, 21 second-feet.
October 4: Discharge, 23 second-feet.
1906—March 1: Discharge, 48 second-feet.
June 23: Discharge, 95 second-feet.
July 11: Discharge, 70 second-feet.
September 5: Discharge, 45 second-feet.

Dotta Spring near Prattville, Cal.—This spring discharges into North Fork Feather River. The following measurements were made 400 feet above its mouth.

1905—June 12: Discharge, 50 second-feet.
July 3: Discharge, 99 second-feet.
August 5: Discharge, 84 second-feet.
September 2: Discharge, 89 second-feet.
October 18: Discharge, 90 second-feet.
December 14: Discharge, 77 second-feet.
1906—June 21: Discharge, 122 second-feet.
August 3: Discharge, 94 second-feet.

Feather River near Bidwell Bar.—The following measurements were made 2 miles below Bidwell Bar and above the junction with North Fork of Feather River during 1905:

June 11: Discharge, 1,525 second-feet.
July 25: Discharge, 410 second-feet.
August 19: Discharge, 279 second-feet.
September 17: Discharge, 256 second-feet.

Flournoy ditch near Genesee, Cal.—This ditch diverts water from Red Clover Creek for irrigation at Flournoy's ranch. A measurement was made August 21, 1906, 1¼ miles southeast of Flournoy, a short distance below the point of diversion:

Width, 4 feet; area, 3.6 square feet; discharge, 9.5 second-feet.

Hamilton Branch of North Fork of Feather River near Prattville, Cal.—The following measurements were made a short distance below its junction with Clear Creek:

1905—July 5: Discharge, 108 second-feet.
August 8: Discharge, 79 second-feet.
September 1: Discharge, 93 second-feet.
October 2: Discharge, 83 second-feet.
December 15: Discharge, 74 second-feet.
1906—June 1: Discharge, 498 second-feet.
July 6: Discharge, 250 second-feet.
August 7: Discharge, 139 second-feet.

The following measurements were made at wagon bridge on east side of Big Meadow and below its junction with Rock Creek:

1905—June 23: Discharge, 169 second-feet.
1906—September 1: Discharge, 232 second-feet.

Hot Springs Valley Creek at Hot Springs Valley.—This creek is a tributary of Warner Creek. The following measurements were made a short distance above its junction with Warner Creek:

1905—June 28: Discharge, 44 second-feet.
August 2: Discharge, 30 second-feet.
August 30: Discharge, 28 second-feet.
October 4: Discharge, 25 second-feet.
1906—May 23: Discharge, 117 second-feet.
July 11: Discharge, 80 second-feet.
September 4: Discharge, 35 second-feet.

Hosselkus ditch near Genesee, Cal.—This ditch diverts water from Little Grizzly Creek. A measurement was made August 20, 1906, 1½ miles southwest of Genesee post-office and a short distance below point of diversion:

Width, 5 feet; area, 3.5 square feet; discharge, 5 second-feet.

Indian Creek.—This creek is one of the principal tributaries of North Fork of Feather River. The following measurements were made a short distance above its mouth during 1905:

June 16: Discharge, 321 second-feet.
September 8: Discharge, 106 second-feet.

Indian Creek near Genesee, Cal.—A measurement of this stream was made August 21, 1906, one-half mile northwest of Flournoy's and above its junction with Red Clover Creek:

Width, 6.5 feet; area, 4.3 square feet; discharge, 3.8 second-feet.

King Creek at Hot Springs Valley, Cal.—This stream is a tributary of Warner Creek. The following measurements were made at crossing of the Prattville-Lassen Peak road, one-half mile above the junction with Warner Creek:

1905—June 28: Discharge, 66 second-feet.
August 2: Discharge, 29 second-feet.
August 30: Discharge, 18 second-feet.
October 4: Discharge, 12.6 second-feet.
1906—May 22: Discharge, 151 second-feet.
July 11: Discharge, 117 second-feet.

Little Grizzly Creek near Genesee, Cal.—This stream is a tributary of Indian Creek. A measurement was made August 20, 1906, 1½ miles southwest of Genesee post-office, above the diversion of the Hosselkus ditch:

Width, 21 feet; area, 21 square feet; discharge, 14.7 second-feet.

Middle Fork of Feather River near Beckwith, Cal.—A measurement of this stream was made August 12, 1906, 2 miles west of Beckwith, Cal., and one-half mile above its junction with Grizzly Creek:

Width, 10 feet; area, 4.4 square feet; discharge, 5 second-feet.

North Arm Creek near Taylorsville, Cal.—This stream is a tributary of Indian Creek. A measurement was made August 22, 1906, at "Dead Fall" bridge, 1¾ miles north of Taylorsville, Cal.:

Width, 14 feet; area, 12.4 square feet; discharge, 5.1 second-feet.

North Fork of Feather River near Tyler, Cal.—The following measurements were made at the bridge on the Prattville-Red Bluff road:

1905—June 29: Discharge, 52 second-feet.
August 2: Discharge, 17.4 second-feet.
August 30: Discharge, 12.4 second-feet.
October 4: Discharge, 11.4 second-feet.
1906—May 23: Discharge, 91 second-feet.
July 10: Discharge, 117 second-feet.

North Fork of Feather River.—The following measurements were made a short distance above its junction with Warner Creek:

1905—August 30: Discharge, 84 second-feet.
October 3: Discharge, 64 second-feet.
1906—May 23: Discharge, 506 second-feet.
July 11: Discharge, 323 second-feet.

North Fork of Feather River near Prattville, Cal.—The following measurements were made at Olsen's ranch, 8 miles northwest of Prattville, Cal.:

1905—June 30: Discharge, 286 second-feet.
August 4: Discharge, 188 second-feet.
August 29: Discharge, 146 second-feet.
October 3: Discharge, 128 second-feet.
1906—March 1: Discharge, 164 second-feet.
May 22: Discharge, 805 second-feet.
July 10: Discharge, 647 second-feet.

Prattville Branch of North Fork of Feather River at Prattville, Cal.—The following measurements were made 800 feet above its junction with North Fork of Feather River:

1905—June 12: Discharge, 186 second-feet.
July 7: Discharge, 196 second-feet.
August 14: Discharge, 180 second-feet.
September 2: Discharge, 179 second-feet.
1906—January 5. Discharge, 147 second-feet.
June 29: Discharge, 303 second-feet.
August 3: Discharge, 227 second-feet.

Red Clover Creek near Genesee, Cal.—This stream is a tributary of Indian Creek. A measurement was made August 21, 1906, 1¼ miles southeast of Flournoy's and above diversion of Flournoy's ditch:

Width, 10 feet; area, 11 square feet; discharge, 21 second feet.

Rock Creek near Prattville, Cal.—This stream is a tributary of Hamilton Branch of North Fork of Feather River. The following measurements were made at bridge on Prattville-Susanville road:

1905—June 24: Discharge, 12 second-feet.
July 5: Discharge, 7.4 second-feet.
August 8: Discharge, 5 second-feet.
September 1: Discharge, 2.1 second-teet.
October 2: Discharge, 1.5 second-feet.
December 15: Discharge, 0.5 second-foot.
1906—June 1: Discharge, 85 second-feet.
July 6: Discharge, 25 second-feet.
August 7: Discharge, 25 second-feet.

South Fork of Feather River near Enterprise, Cal.—The following measurements, which include the flow in the Enterprise ditch, were made a short distance above its junction with Feather River during 1905:

June 11: Discharge, 246 second-feet.
July 25: Discharge, 64 second-feet.
August 18: Discharge, 48 second-feet.
September 17: Discharge, 34 second-feet.

Spanish Creek near Quincy, Cal.—This stream is a tributary of Indian Creek. A measurement was made September 9, 1906, at the wagon bridge, 2½ miles northeast of Quincy, Cal.:

Width, 40 feet; area, 40 feet; discharge, 44 second-feet.

Squaw Queen Creek near Genesee, Cal.—This stream is a tributary of Red Clover Creek. A measurement was made August 21, 1906, three-fourths mile southeast of Flournoy and 500 feet above its junction with Clover Creek:

Width, 6 feet; area, 3.6 square feet; discharge, 2.3 second-feet.

Warner Creek near Chester, Cal.—This stream is a tributary of the North Fork of Feather River. The following measurements were made at bridge on Prattville-Red Bluff road:

1905—June 30: Discharge, 140 second-feet.
August 5: Discharge, 81 second-feet.
August 29: Discharge, 63 second-feet.
October 3: Discharge, 61 second-feet.
1906—May 23: Discharge, 320 second-feet.
July 10: Discharge, 268 second-feet.
September 4: Discharge, 95 second-feet.

Ward Creek near Genesee, Cal.—This stream is a tributary of Indian Creek. A measurement was made August 22, 1906, at Phelan's ranch house, 1½ miles above its junction with Indian Creek:

Width, 8 feet; area, 3.2 square feet; discharge, 8.1 second-feet.

Willow Creek near Chester, Cal.—This stream is a tributary of North Fork of Feather River. The following measurements were made at the ford on the Prattville-Red Bluff road:

1905—June 29: Discharge, 4.1 second-feet.
August 2: Discharge, 4.0 second-feet.
October 4: Discharge, 2.5 second-feet.
1906—May 23: Discharge, 40 second-feet.

Wolf Creek near Greenville, Cal.—This stream is a tributary of Indian Creek, discharging through swamp in west arm of Indian Valley. A measurement was made August 23, 1906, one-fourth mile southwest of Greenville, Cal., above its junction with North Canyon, a stream which discharges from Round Valley Reservoir. A diversion of 3.4 second-feet for irrigation is made above point of measurement.

Width, 3 feet; area, 1.2 square feet; discharge, 1.8 second-feet.

PRECIPITATION AND EVAPORATION DATA.

The following tables give the total precipitation and evaporation, in inches, by months at Prattville, Cal.:

Precipitation and evaporation at Prattville, Cal.

PRECIPITATION.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1905							0.00	0.17	0.70	0.28	2.77	1.74	
1906	16.20	6.45	14.42	0.73	4.99	1.42	0.34	0.15	0.53	0.20	3.91	14.68	64.02

EVAPORATION.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
1905							3.81	4.31	3.80	2.72	1.50	1.00	
1906	1.30	0.95	1.16	2.84	2.58	2.77	3.86	3.42	2.72	3.06	1.28	0.41	26.35

YUBA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yuba River is a tributary of Feather River, which it enters at Marysville, 30 miles above the junction of Feather and Sacramento rivers. The entire drainage area of the Yuba is about 1,327 square miles, of which about 1,220 square miles are above the gaging station at Smartsville. Its extreme length is about 60 miles, and extreme width 56 miles. In the lower stretches of the river, at the location of the present gaging station and in the valley below, the channel has been filled to a considerable depth with débris from hydraulic mining.

The drainage basin is subdivided into 5 small basins, namely: North Fork, with a drainage area of 491.6 square miles; Middle Fork, with a drainage area of 218 square miles; South Fork, with a drainage area of 360 square miles; Deer Creek, with a drainage of 89.6 square miles, and Dry Creek, with a drainage area of 105.5 square miles. The latter tributary discharges into the main river about 5 miles below the gaging station. The watershed rises gently in rounded and broken mountains, to the crest of the Sierra Nevada, which at the headwaters of the Yuba has a mean elevation of about 8,200 feet, with peaks rising to a height of 9,100 feet. From Mount Lincoln—a peak common to the watersheds of the Yuba, American, and Truckee rivers—to a point about 2½ miles northeast of Mount Weber, the summit of the Sierre Nevada divides the watershed of Yuba River from that of Truckee River, which discharges into Humboldt Basin. Farther north from Mount Weber there is a secondary crest which divides the watersheds of Yuba and Feather rivers, the watershed of the latter stream reaching farther east to a less elevated divide in which the passes are lower than those of the easterly crest.

The western and lower portions of the Yuba drainage basin are composed of slate and kindred rock, very much eroded and merging into the gravel and alluvial deposits of the Sacramento Valley. The upper portions of the basin are composed principally of lavas and granites, all depely eroded, particularly the lavas. A stratum of serpentine traverses the watershed of the Yuba River in a direction generally parallel with the crest of the Sierra. North Fork rises in lavas which vary much in composition and hardness, but which generally have a deep soil covering, with timber and brush growth. Middle Fork rises in similar lavas and granite. The main and tributary streams fall rapidly, and their canyons head well up in the mountains. The sides of these canyons are covered with timber and brush, which, with the deep soil, retain the moisture and feed numerous perennial springs. In the case of North Fork this is particularly noticeable. The forests of its watersheds make a reliable and constant stream. The mean annual precipitation for the basins of North and Middle forks is about 54 inches. Warm rains on soft snow sometimes give high flood discharge, but snow remains on the higher peaks until midsummer. The headwaters of South Fork lie upon a broad granite surface into which the streams have not cut deeply until the main stream reaches a point 16 miles from the summit, where it drops rapidly into a deeply eroded canyon. This part of the basin has a precipitation annually of about 60 inches. The entire drainage area of the Yuba contains nearly 100 small glacial lakes.

YUBA RIVER NEAR SMARTSVILLE, CAL.

This station was established June 2, 1903. It is located at what is called "The Narrows," 1 mile from Smartsville, Cal., 18 miles from the Southern Pacific Railroad station at Wheatland, Cal., and 20 miles from Marysville, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 160, where are given also references to publications that contain data for previous years.

Discharge measurements of Yuba River near Smartsville, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 4	J. R. McKeel	73	147	1.70	580
January 11	do	79	153	1.80	601
January 25	do	190	1,400	6.30	3,650
January 30	do	189	984	5.70	2,680
February 4	do	187	663	5.40	2,270
February 9	F. R. S. Buttemer	189	578	5.32	1,930
February 11	J. R. McKeel	188	631	5.50	2,400
February 15	R. S. Hawley	260	1,570	8.00	8,990
March 9	do	210	1,020	6.85	5,340
March 10	do	210	1,020	6.90	5,550
March 23	do	280	1,850	9.80	17,400
March 24	do	300	2,660	12.20	29,300
April 10	Hawley and Sawyer	240	1,280	7.20	8,290
April 17	W. C. Sawyer	242	1,340	7.20	8,100
April 18	do	240	1,380	7.20	8,270
April 26	do	210	1,320	6.66	6,600
May 3	do	257	1,650	7.70	11,500
May 4	do	257	1,580	7.70	10,900
May 5	do	260	1,820	8.15	13,200
May 18	do	173	1,180	6.07	6,420
July 10	R. S. Hawley	162	1,010	2.47	4,440
July 11	do	160	965	2.23	4,020
July 24	do	156	710	0.95	1,870
July 25	do	156	679	0.75	1,590
August 6	J. R. McKeel	150	560	9.80	1,000
August 20	do	150	505	9.45	701
August 30	do	150	484	9.35	661
September 9	do	150	459	9.25	548
September 16	do	150	469	9.30	577
September 24	do	150	487	9.20	575
October 2	R. S. Hawley	147	440	9.10	422
October 25	do	146	453	9.10	423

Daily gage height, in feet, of Yuba River near Smartsville, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	5.5	7.4	9.7	7.1	6.3	3.5	10.0	9.4	9.1	9.0	9.3
2	1.7	5.5	7.0	8.7	7.5	6.4	3.8	9.9	9.3	9.1	9.1	9.3
3	1.7	5.5	7.5	8.0	7.9	6.7	4.0	9.9	9.3	9.1	9.1	9.3
4	1.7	5.4	7.3	7.5	8.0	10.0	3.7	9.8	9.3	9.1	12.7	9.3
5	1.7	5.4	6.9	7.3	8.1	8.0	3.5	[a]9.8	9.3	9.1	10.6	9.3
6	1.7	5.4	6.7	7.2	8.0	7.0	3.2	9.8	9.3	9.0	10.0	9.3
7	1.7	5.3	6.8	7.2	8.0	6.5	3.0	9.8	9.3	9.0	9.7	9.3
8	1.7	5.3	6.8	7.3	8.0	6.1	2.8	9.7	9.3	9.0	9.5	10.9
9	1.6	5.3	6.8	7.3	8.2	6.3	2.6	9.7	9.2	9.0	9.5	10.2
10	1.8	5.6	6.9	7.3	8.1	[a]6.7	2.5	9.7	9.2	9.0	9.4	10.9
11	1.8	5.5	7.0	7.1	8.4	7.0	2.1	9.7	9.2	9.0	9.4	17.0
12	4.7	5.4	12.0	7.0	7.6	8.0	2.4	[a]9.6	9.2	9.0	9.4	12.7
13	9.7	5.3	8.8	7.1	7.0	6.6	2.3	9.6	9.2	9.0	9.4	11.7
14	8.5	5.4	8.8	7.0	[a]7.1	5.7	2.2	9.6	9.2	9.0	9.4	11.0
15	11.0	8.3	8.1	7.2	7.3	5.7	1.8	9.6	9.3	9.0	9.4	10.8
16	11.0	6.7	7.5	7.2	6.3	7.0	1.7	9.6	9.3	9.0	9.6	10.7
17	9.7	6.1	7.2	7.3	6.2	5.8	1.6	9.5	9.2	9.1	9.5	10.6
18	17.0	6.4	[a]6.9	7.3	6.1	5.0	1.6	9.5	9.2	9.1	9.4	10.5
19	13.0	8.5	6.7	7.4	6.2	6.2	1.4	9.5	[a]9.2	9.1	9.3	10.4
20	8.9	7.0	6.6	7.5	6.3	5.9	1.2	9.5	9.2	9.1	9.3	10.4
21	8.0	8.4	7.1	7.5	6.2	5.3	1.1	9.5	9.2	9.1	9.3	10.4
22	7.4	7.4	9.6	7.5	6.1	5.0	1.0	9.5	9.2	9.1	9.3	10.4
23	7.0	7.7	10.0	7.3	5.9	5.1	1.0	9.5	9.2	9.1	9.3	11.4
24	6.7	7.7	12.2	7.0	5.5	4.3	0.9	9.5	9.2	9.0	9.3	11.4
25	6.3	7.8	11.6	6.7	6.6	4.2	0.8	9.5	9.2	9.0	9.3	15.4
26	6.1	7.4	12.4	6.8	8.8	4.0	.7	[a]9.4	9.2	9.0	9.3	18.9
27	6.0	8.5	9.5	6.6	8.7	3.8	.6	9.4	9.2	9.0	9.3	13.8
28	[a]5.9	8.0	8.6	6.4	9.0	3.7	.5	9.4	9.2	9.0	9.3	12.8
29	5.8	....	8.0	6.7	7.7	3.5	[a].4	[a]9.4	9.2	9.0	9.2	11.8
30	5.7	....	9.4	6.8	6.7	3.5	.3	9.4	9.1	9.0	9.3	12.4
31	5.6	....	14.0	....	6.3	....	.2	9.4	....	9.0	....	12.4

[a] Estimated.

NOTE.—The datum of the gage was lowered 10 feet August 1.

Daily discharge, in second-feet, of Yuba River near Smartsville, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	600	2,390	6,810	18,100	9,000	8,900	5,200	1,040	620	440	380	560
2	555	2,390	5,550	13,500	10,500	9,350	6,000	920	560	440	440	560
3	555	2,390	7,150	11,700	12,400	10,500	6,600	920	560	440	440	560
4	555	2,250	6,480	9,100	11,600	25,600	6,000	860	560	440	5,000	560
5	555	2,250	5,260	8,600	13,000	16,500	5,800	860	560	440	1,540	560
6	555	2,250	4,730	8,300	12,500	12,200	5,300	860	560	380	1,040	560
7	555	2,120	4,990	8,350	12,500	10,400	5,000	860	560	380	800	560
8	555	2,120	4,990	8,700	12,500	9,200	4,800	800	560	380	680	1,880
9	515	2,120	4,990	8,700	13,600	10,100	4,550	800	500	380	680	1,170
10	600	2,540	5,260	8,600	13,200	11,700	4,520	800	500	380	520	1,880
11	600	2,390	5,550	8,000	14,400	13,100	3,720	800	500	380	520	16,800
12	3,590	2,250	28,400	7,700	11,400	18,000	4,320	740	500	380	520	5,850
13	16,900	2,120	12,500	7,950	8,600	11,700	4,120	740	500	380	520	4,100
14	11,500	2,250	12,500	7,500	9,300	8,700	3,920	740	500	380	520	3,100
15	18,900	10,200	9,400	8,100	10,000	8,800	3,130	740	560	380	520	2,850
16	18,900	4,730	7,150	8,100	0,950	14,100	2,950	740	560	380	740	2,700
17	16,900	3,400	6,160	8,500	6,700	9,450	2,780	680	500	440	680	2,600
18	48,000	4,010	5,260	8,500	6,500	7,200	2,780	680	500	440	520	2,500
19	33,000	11,100	4,730	8,900	6,800	11,700	2,450	680	500	440	560	2,350
20	13,000	5,550	4,480	9,200	7,200	10,300	2,160	680	500	440	560	2,350
21	9,000	10,700	5,850	9,200	7,150	8,400	2,030	680	500	440	560	2,350
22	6,810	6,810	16,400	9,200	7,000	8,200	1,900	680	500	440	560	2,350
23	5,550	7,850	18,400	8,600	6,500	8,100	1,900	680	500	440	560	3,700
24	4,730	7,850	29,400	7,650	5,750	6,100	1,880	680	500	380	560	3,700
25	3,800	8,230	26,400	6,800	8,900	6,000	1,760	680	500	380	560	11,300
26	3,400	6,810	30,400	7,050	18,700	5,700	1,650	620	500	380	560	22,800
27	3,210	11,100	15,900	7,000	18,200	5,400	1,540	620	500	380	560	8,000
28	3,040	9,000	11,600	6,450	20,100	5,300	1,440	620	500	380	560	6,000
29	2,860	....	9,000	7,350	13,700	5,000	1,340	620	500	380	500	4,200
30	2,700	....	15,400	7,800	10,000	5,100	1,250	620	440	380	560	5,300
31	2,540	....	40,600	....	8,800	....	1,170	620	......	380	......	5,300

NOTE.—These discharges were obtained partly by rating tables and partly by the indirect method for shifting channels.

Monthly discharge of Yuba River near Smartsville, Cal., for 1906.

[Drainage area, 1,220 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	48,000	515	7,560	465,000	6.20	7.15
February	11,100	2,120	4,970	276,000	4.07	4.24
March	40,600	4,480	12,000	738,000	9.84	11.34
April	18,100	6,450	8,770	522,000	7.19	8.02
May	20,100	5,750	10,800	664,000	8.85	10.20
June	25,600	5,000	10,000	595,000	8.20	9.15
July	6,600	1,170	3,350	206,000	2.75	3.17
August	1,040	620	744	45,700	.610	.70
September	620	440	520	30,900	.426	.48
October	440	380	403	24,800	.330	.38
November	5,000	380	757	45,000	.620	.69
December	22,800	560	4,130	254,000	3.39	3.91
The year	48,000	380	5,330	3,870,000	4.37	59.43

NOTE.—Values are rated as follows: February and March, excellent; June, November, and December, fair, on account of the lack of measurements; remainder of 1906, good.

BEAR RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Bear River drains an area of 287 square miles between Yuba and American rivers. Its headwaters do not reach back to the crest of the range, so that it seldom receives precipitation in the form of lasting snow. It is torrential in character, having no forested areas except in its upper portion. The rainfall records kept by the Central Pacific from Auburn to Emigrant Gap are indicative of the precipitation in the southern part of its basin. A 28-year record at Grass Valley in the northern portion of its watershed gives a mean of 49.41 inches.

BEAR RIVER ABOVE WHEATLAND, CAL.

This station was established on October 8, 1904. It is located about 800 feet below McCourtney Crossing and 8 miles above Wheatland. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 165, where are given also references to publications that contain data for previous years.

Discharge measurements of Bear River above Wheatland, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 10	F. R. S. Buttemer	123	117	4.55	337
February 26	do	156	323	6.10	1,430
March 10	do	118	222	4.97	862
March 18	do	137	284	5.60	1,330[a]
April 12	W. C. Sawyer	144	232	5.34	981
April 19	do	139	181	4.83	650
April 27	do	140	186	4.85	664
April 27	do	141	236	5.22	979
May 19	do	130	122	4.02	274
July 12	R. S. Hawley	53	57	3.57	168
July 24	do	58	38	3.30	73
July 25	do	75	61	3.28	64
October 3	do	25	20	3.06	31

Daily gage height, in feet, of Bear River above Wheatland, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.2	4.6	6.0	8.7	4.5	5.2	3.9	3.2	3.0	3.0	3.1	3.3
2	3.1	4.6	5.7	7.3	4.6	5.0	3.9	3.2	3.0	3.0	3.1	3.3
3	3.1	4.5	5.5	6.8	4.5	5.0	3.8	3.1	3.0	3.0	3.2	3.3
4	3.1	4.5	6.5	6.4	4.4	6.0	3.8	3.1	3.0	3.0	4.45	3.3
5	3.0	4.5	5.8	6.2	4.4	5.4	3.7	3.1	3.0	3.0	3.9	3.3
6	3.0	4.4	5.5	6.0	4.4	5.7	3.7	3.1	3.0	3.0	3.6	3.3
7	3.1	4.4	5.3	5.8	4.3	5.2	3.7	3.1	3.0	3.0	3.5	3.3
8	3.0	4.4	5.1	5.6	4.3	5.0	3.7	3.1	3.0	3.0	3.4	4.65
9	3.0	4.5	5.0	5.4	4.3	4.8	3.6	3.1	3.0	3.0	3.3	3.9
10	3.0	4.6	4.9	5.5	4.3	4.7	3.6	3.1	3.0	3.0	3.3	3.9
11	3.0	4.7	4.8	5.7	4.4	4.6	3.6	3.1	3.0	3.0	3.3	11.9
12	3.9	4.5	7.55	5.4	4.4	4.7	3.5	3.1	3.0	3.0	3.3	9.2
13	10.35	4.5	6.3	5.2	4.3	4.5	3.5	3.0	3.0	3.1	3.3	6.6
14	6.8	4.4	7.6	5.1	4.2	4.5	3.5	3.0	3.1	3.1	3.3	4.6
15	10.5	6.4	8.7	5.0	4.6	4.4	3.4	3.0	3.1	3.0	3.3	4.2
16	11.65	5.4	6.6	5.0	4.3	4.9	3.4	3.0	3.1	3.0	3.4	4.0
17	8.5	5.1	6.1	4.9	4.2	4.5	3.4	3.1	3.1	3.1	3.3	3.9
18	14.55	4.9	5.7	4.9	4.2	4.4	3.3	3.0	3.1	3.1	3.3	3.8
19	12.25	6.9	5.4	4.8	4.1	4.3	3.3	3.0	3.1	3.1	3.3	3.8
20	9.5	5.9	5.2	4.8	4.1	4.3	3.3	3.0	3.1	3.1	3.3	3.8
21	6.5	7.7	5.7	4.8	4.1	4.2	3.3	3.0	3.0	3.1	3.3	3.7
22	6.0	6.7	7.2	4.7	4.1	4.2	3.3	3.0	3.0	3.1	3.3	3.7
23	5.7	7.3	6.8	4.75	4.0	4.2	3.2	3.0	3.0	3.1	3.3	4.7
24	5.4	6.5	11.7	4.85	4.0	4.2	3.3	3.0	3.1	3.1	3.3	4.2
25	5.2	6.9	10.5	5.1	4.45	4.1	3.3	3.0	3.1	3.1	3.3	6.45
26	5.0	6.1	12.3	4.8	5.6	4.1	3.2	3.0	3.1	3.1	3.2	10.75
27	4.9	6.55	8.3	4.9	6.85	4.1	3.2	3.0	3.1	3.1	3.2	8.50
28	4.8	7.0	7.2	5.0	8.65	4.1	3.2	3.0	3.1	3.1	3.3	6.0
29	4.7	......	6.8	4.7	6.6	4.0	3.2	3.0	3.1	3.0	3.3	5.3
30	4.7	......	7.4	4.7	5.9	4.0	3.2	3.0	3.1	3.1	3.3	4.9
31	4.6	......	15.25	......	5.4	......	3.2	3.0	......	3.1	......	7.0

Rating table for Bear River above Wheatland, Cal., for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	20	4.10	328	5.20	1,015	6.60	2,640	8.80	6,640
3.10	33	4.20	375	5.30	1,105	6.80	2,935	9.00	7,060
3.20	49	4.30	425	5.40	1,200	7.00	3,250	10.00	9,160
3.30	69	4.40	475	5.50	1,300	7.20	3,575	11.00	11,360
3.40	92	4.50	530	5.60	1,405	7.40	3,910	12.00	13,660
3.50	118	4.60	585	5.70	1,515	7.60	4,265	13.00	15,960
3.60	146	4.70	645	5.80	1,625	7.80	4,635	14.00	18,360
3.70	177	4.80	710	5.90	1,740	8.00	5,020		
3.80	210	4.90	780	6.00	1,860	8.20	5,410		
3.90	246	5.00	855	6.20	2,105	8.40	5,810		
4.00	285	5.10	930	6.40	2,365	8.60	6,220		

NOTE.—This table is based on discharge measurements made during 1904–1906, and is well defined between gage heights 3.1 feet and 5.1 feet.

Monthly discharge of Bear River above Wheatland, Cal., for 1906.

[Drainage area, 263 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	19,700	20	3,130	192,000	11.90	13.72
February	4,450	475	1,500	83,300	5.70	5.94
March	21,400	710	3,970	244,000	15.10	17.41
April	6,430	645	1,390	82,700	5.28	5.89
May	6,320	285	870	53,500	3.31	3.82
June	1,860	285	644	38,300	2.45	2.73
July	246	49	113	6,950	.430	.50
August	49	20	26.5	1,630	.101	.12
September	33	20	26.1	1,550	.099	.11
October	33	20	26.7	1,640	.102	.12
November	502	33	90.7	5,400	.345	.38
December	13,400	69	1,770	109,000	6.73	7.76
The year	21,400	20	1,130	820,000	4.29	58.50

NOTE.—These values are fair.

AMERICAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

American River drains an area of about 2,000 square miles of the western slope of the Sierra Nevada. This drainage basin lies between those of the Bear and Yuba rivers on the north and that of Consumnes River on the south. It has three main forks, heading in the summit of the range, which reaches an elevation of about 9,000 feet. The country lying between these main forks is drained by numerous small tributaries. The formation in the higher and greater portions of this basin is of granite, with a considerable timber growth. The flow is rather torrential during the winter months, due to the large area of barren and sparsely timbered country in the lower portion of the watershed. The precipitation on the higher elevations is in the form of snow, which usually melts late in the spring. Rainfall records have been kept along the line of the Central Pacific Railroad, which follows the ridge to the north of North Fork.

The mean annual rainfall at Auburn is 33.40 inches, that at Colfax 47.4 inches, and at Cisco and Emigrant Gap about 50 inches. At Georgetown, between North and Middle forks, a 30-year record has an average of 56.72 inches, and at Placerville, above South Fork, another of about the same length shows 43.58 inches.

There are several small lakes in the upper reaches of this basin, the capacity of a few having been increased by the construction of low dams at their outlets. Their water is stored for mining purposes during the low-water flow and is used entirely within the drainage basin.

AMERICAN RIVER NEAR FAIROAKS, CAL.

This station was established November 3, 1904, at Fairoaks Bridge, near Fairoaks. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 176, where are given also references to publications that contain data for previous years.

Discharge measurements of American River near Fairoaks, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 13	F. R. S. Buttemer	300	1,400	3.66	2,090
March 3	do	352	2,180	5.95	6,480
April 6	R. S. Hawley	360	2,490	7.30	9,670
April 13	W. C. Sawyer	376	2,580	7.26	9,970
April 23	do	367	2,940	8.54	13,800
April 30	do	352	2,450	7.24	9,420
April 30	do	352	2,390	7.15	10,200
May 21	do	354	2,640	7.80	11,500
May 21	do	354	2,680	7.90	11,800
June 11	do	370	3,510	10.50	20,600
June 18	do	360	3,000	9.00	15,800
June 26	do	369	2,770	8.35	13,200
July 7	do	366	2,620	7.90	12,100
July 16	do	354	1,730	5.40	5,340
July 27	do	345	1,260	4.00	2,780
August 8	Sawyer and Martin	248	854	2.68	1,350
September 3	W. F. Martin	210	648	1.75	564
November 26	do	205	620	1.64	476
November 27	R. S. Hawley	206	569	1.45	402

Daily gage height, in feet, of American River near Fairoaks, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	3.65	6.8	10.4	7.6	9.1	7.45	3.35	1.8	1.3	1.35	1.5
2	1.4	3.55	6.4	9.6	8.45	9.45	8.35	3.15	1.75	1.4	1.4	1.5
3	1.4	3.7	7.9	8.8	8.45	10.3	8.25	3.2	1.8	1.35	1.55	1.5
4	1.5	3.6	7.65	8.25	9.2	9.75	8.0	3.1	1.7	1.3	1.95	1.5
5	1.2	3.65	6.3	7.4	10.4	9.1	8.15	2.95	1.8	1.3	3.4	1.5
6	1.2	3.75	5.95	7.1	9.85	8.7	7.4	2.75	1.65	1.3	2.75	1.5
7	1.5	3.7	5.95	7.15	10.3	9.0	7.25	2.7	1.6	1.3	2.25	1.5
8	1.2	3.75	5.95	7.6	10.25	9.25	7.05	2.75	1.6	1.3	1.9	2.15
9	1.4	3.8	6.1	7.35	9.6	9.25	6.9	2.7	1.6	1.3	1.75	2.75
10	1.2	4.1	6.15	7.65	9.75	9.75	6.2	2.65	1.5	1.3	1.6	2.45
11	1.4	3.85	6.45	......	10.1	10.8	6.0	2.7	1.5	1.3	1.6	10.25
12	1.75	3.7	9.25	......	9.85	11.0	5.85	2.7	1.5	1.25	1.55	7.15
13	5.85	3.75	9.7	7.2	8.7	9.95	5.8	2.45	1.5	1.2	1.6	4.65
14	8.35	4.2	12.85	7.2	8.0	9.1	5.9	2.4	1.5	1.25	1.6	3.7
15	6.75	6.05	11.35	7.65	8.05	8.9	5.65	2.4	1.6	1.2	1.6	3.3

Daily gage height, in feet, of American River near Fairoaks, Cal., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	9.3	6.05	8.85	8.0	7.75	9.8	5.45	2.25	1.7	1.2	1.7	2.85
17	10.55	6.0	8.3	8.0	7.5	9.85	5.3	2.2	1.6	1.25	1.8	2.65
18	15.45	5.3	6.65	8.1	7.7	9.45	5.0	2.15	1.5	1.2	1.7	2.55
19	15.5	8.35	6.2	7.85	7.35	8.25	4.8	2.1	1.5	1.25	1.6	2.5
20	9.85	6.6	6.0	7.7	7.25	8.8	4.6	2.1	1.4	1.3	1.6	2.45
21	6.85	9.35	6.0	7.6	7.7	9.7	4.6	2.1	1.4	1.3	1.6	2.4
22	6.25	8.35	8.1	8.2	7.6	10.25	4.4	2.15	1.3	1.3	1.6	2.8
23	5.2	7.0	9.95	8.7	7.4	10.25	4.35	2.1	1.3	1.3	1.6	3.65
24	5.05	6.65	13.35	8.5	7.15	9.4	4.35	2.0	1.3	1.3	1.6	3.55
25	4.9	7.0	12.65	7.95	7.1	8.35	4.4	2.0	1.35	1.3	1.6	5.7
26	4.4	6.5	12.00	7.65	9.75	8.1	4.35	1.85	1.3	1.3	1.6	9.95
27	4.05	6.5	10.45	8.3	9.7	7.1	4.15	1.9	1.35	1.3	1.5	9.45
28	4.25	7.8	9.15	8.45	11.75	6.85	3.95	1.7	1.4	1.35	1.5	6.25
29	4.0	....	7.85	8.2	11.25	6.85	3.95	1.7	1.3	1.4	1.5	5.15
30	3.7	....	8.45	7.6	8.85	6.65	3.7	1.7	1.35	1.35	1.5	5.5
31	3.65	....	9.25	....	8.6	....	3.5	1.75	....	1.4	....	5.8

Rating table for American River near Fairoaks, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	300	2.30	910	3.40	1,980	5.00	4,380	8.00	12,100
1.30	340	2.40	990	3.50	2,090	5.20	4,780	9.00	15,380
1.40	380	2.50	1,070	3.60	2,200	5.40	5,180	10.00	18,980
1.50	420	2.60	1,160	3.70	2,310	5.60	5,600	11.00	22,900
1.60	470	2.70	1,250	3.80	2,420	5.80	6,040	12.00	27,100
1.70	520	2.80	1,350	3.90	2,540	6.00	6,540	13.00	31,300
1.80	570	2.90	1,450	4.00	2,660	6.20	7,060	14.00	35,500
1.90	630	3.00	1,550	4.20	2,920	6.40	7,580	15.00	39,700
2.00	690	3.10	1.650	4.40	3,260	6.00	8,100	16.00	43,900
2.10	760	3.20	1,760	4.60	3,620	6.80	8,620		
2.20	830	3.30	1,870	4.80	3,980	7.00	9,140		

NOTE.—This table is based on 19 discharge measurements made during 1906, and is well defined between gage heights 1.4 feet and 10.5 feet.

Monthly discharge of American River near Fairoaks, Cal., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum	Minimum.	Mean.	
January	41,800	300	7,010	431,000
February	16,600	2,140	5,830	324,000
March	32,800	6,410	13,900	855,000
April	20,500	9,420	[a] 12,100	720,000
May	26,000	9,420	15,000	922,000
June	22,900	8,230	15,900	946,000
July	13,200	2,090	6,180	380,000
August	1,920	520	1,010	62,100
September	570	340	433	25,800
October	380	300	338	20,800
November	1,980	360	567	33,700
December	19,900	420	3,900	240,000
The year	41,800	300	6,850	4,960,000

[a] Discharge for April 11 and 12 interpolated.

NOTE.—These values are excellent.

SAN JOAQUIN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

San Joaquin River is divided into two distinct parts. The valley portion forms the central drainage line of the San Joaquin Valley, and during the spring is navigable for 100 miles or more. Stanislaus, Tuolumne, Merced, and Kings rivers are the largest streams in this portion of the drainage basin. The waters of Kings, Kaweah, Tule, and Kern rivers, which are located in the portion of the San Joaquin Valley south and east of Fresno, although forming a portion of the drainage of San Joaquin River, seldom reach this stream, their entire flow, except in extreme flood, being diverted and used for irrigation at points where they emerge from the foothills. The valley is fertile and almost destitute of timber. The mountainous portion of the stream drains the western slope of the Sierra Nevada between Merced River on the north and Kings River on the south, the crest of its divide reaching an elevation of 13,000 feet in Mount Lyell and an elevation of 14,000 feet in Mount Goddard. There are numerous tributaries in this portion of the drainage basin, many of which have their source in the high elevations. The formation is of granite, which in the upper reaches is bare and sharply marked by glacial action. The middle reaches of the basin are well timbered, the timber diminishing on the lower foothills, which have a covering of brush and grass. The precipitation takes the form of snow on the higher elevations. The fall of the river is rapid, with many favorable locations for power development. There are numerous lakes in the upper reaches of the basin. A storage reservoir has been constructed on North Fork, which will tend to further regulate the flow of the river.

MAIN SAN JOAQUIN RIVER.

SAN JOAQUIN RIVER AT HERNDON, CAL.

The gage rod at this station was established by the engineering department of the Southern Pacific Railroad Company in 1879. The old trestle bridge was torn down by the railroad company during 1899 and a new iron structure was erected in its place. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 184, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of San Joaquin River at Herndon, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.65	3.25	4.2	8.5	6.4	8.4	10.5	8.2	4.35	3.2	3.0	2.6
2	2.65	3.25	3.75	7.0	6.75	8.25	11.25	7.65	4.35	3.2	3.0	2.6
3	2.65	3.1	3.75	6.65	7.5	8.5	11.4	7.2	4.35	3.2	3.0	2.6
4	2.65	3.1	5.6	6.5	8.35	8.75	12.5	7.0	4.25	3.2	3.0	2.5
5	2.65	3.1	4.5	6.35	8.5	8.65	12.25	7.0	4.25	3.2	3.0	2.5
6	2.65	3.1	4.25	5.75	9.4	9.35	12.0	7.0	4.25	3.2	3.0	2.5
7	2.65	3.1	4.1	5.65	9.65	8.5	12.0	6.65	4.2	3.1	3.0	2.5
8	2.65	3.1	4.0	5.65	10.0	9.0	11.75	6.6	4.2	3.1	3.0	2.5
9	2.65	3.1	4.2	6.0	9.75	10.25	11.65	6.6	4.2	3.1	3.0	2.5
10	2.65	3.0	4.25	6.5	11.0	11.0	11.0	6.4	4.0	3.1	3.0	2.5
11	2.65	3.0	4.25	7.35	12.35	11.5	10.65	6.25	4.0	3.1	3.0	2.5
12	2.65	3.0	6.75	6.65	12.0	12.5	11.0	6.25	3.65	3.1	3.0	2.5
13	2.65	3.0	6.35	6.65	11.25	12.75	10.65	6.5	3.65	3.1	3.0	3.0
14	10.5	3.25	6.0	6.4	10.2	11.75	10.65	6.5	3.6	3.1	3.0	3.5
15	6.5	3.4	10.0	6.65	9.65	11.5	10.65	6.4	3.5	3.1	3.0	3.25
16	4.9	3.4	8.5	6.65	9.0	12.0	10.5	6.2	3.5	3.1	3.0	3.25
17	4.0	3.65	7.2	6.65	9.25	13.0	10.5	6.2	3.5	3.1	3.0	3.1
18	4.0	4.2	7.0	7.0	9.5	12.0	10.5	6.1	3.4	3.0	3.0	3.0
19	13.0	4.2	6.0	7.5	10.4	12.35	10.0	6.1	3.4	3.0	3.0	3.0
20	9.0	4.1	6.0	8.2	10.5	13.2	9.65	6.0	3.35	3.0	3.0	3.0
21	7.35	4.0	6.0	8.0	10.65	14.35	9.5	6.0	3.35	3.0	3.0	3.0
22	5.2	4.0	6.35	8.4	10.0	13.65	9.5	6.0	3.35	3.0	3.0	3.0
23	4.5	4.2	9.00	10.0	10.35	13.0	9.75	5.65	3.35	3.0	3.0	3.0
24	4.2	4.25	8.5	8.35	10.0	13.0	10.35	5.65	3.35	3.0	3.0	3.0
25	4.0	4.25	8.4	7.75	9.35	12.65	10.0	5.5	3.2	3.0	3.0	3.0
26	4.0	4.2	8.0	7.75	9.75	12.35	10.0	5.5	3.2	3.0	3.0	3.5
27	4.0	4.2	7.5	7.65	10.65	11.2	9.65	5.35	3.2	3.0	3.0	3.65
28	4.0	4.2	7.2	8.0	11.6	11.0	9.5	5.0	3.2	3.0	3.0	3.65
29	3.75	......	6.5	7.75	10.35	10.35	9.0	4.65	3.2	3.0	2.85	3.75
30	3.5	......	7.35	6.75	10.0	10.0	8.5	4.5	3.2	3.0	2.6	3.75
31	3.4	......	8.25	......	9.65	......	8.25	4.5	......	3.0	......	3.75

NOTE.—Gage heights have been reduced to feet and tenths from feet and inches as furnished by the Southern Pacific Railroad Company.

MISCELLANEOUS MEASUREMENT IN SAN JOAQUIN RIVER DRAINAGE BASIN.

The following measurement was made of San Joaquin River November 21, 1906, from the bridge at Polasky, Cal.:

Width, 133 feet; area, 194 square feet; discharge, 333 second-feet.

KERN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kern River drains 2,345 square miles of the western slope of the Sierra Nevada at its extreme southern limits. This drainage basin is the largest of any stream discharging into the San Joaquin Valley, having an area 600 square miles greater than that of Kings River. It has its source in the highest elevations of the Sierra Nevada, draining the western and southern slopes of Mount Whitney and numerous other high granite peaks grouped about it, which reach elevations of over 14,000 feet. Its general direction is south for about 65 miles, when it turns and flows in a southwesterly direction, discharging into the San Joaquin Valley east of Bakersfield, Cal. Extending, as it does in its upper reaches, for some distance parallel with the Sierra Nevada, it receives waters not only from the main crest on the east, but also from a somewhat lower divide on the west behind the basins of the Kaweah and Tule rivers. It has numerous tributaries, the principal ones, which drain the higher elevations of the main crest of the Sierra Nevada, entering from the east. The topography is extremely rough and broken in the upper reaches of this basin, becoming less rugged in the middle portion in the vicinity of Kernville, where there is quite an extensive valley with considerable cultivated land; below this point the stream enters a rough canyon, finally discharging into the flat country of the San Joaquin Valley. The entire flow, except during extreme flood stages, is diverted and used for irrigation at points where streams emerge from the foothills.

The formation is of granite, which, above the 10,000-foot contour, is practically bare of timber growth. Between elevations of 3,000 and 10,000 feet there is a good depth of soil, with timber and brush covering; the lower reaches have a light covering of brush and grass.

There are several lakes and marshes scattered throughout this basin, but they are less numerous than in the basins farther to the north. Several power plants are located on this stream, none of which, however, receive water from storage reservoirs, the diversions being made from the natural flow of the river and again returned to the river channel. The precipitation is very light throughout this basin, with the possible exception of the high elevations surrounding Mount Whitney, where the snow remains through the summer months.

KERN RIVER NEAR BAKERSFIELD, CAL.

This station, established in 1893 by Walter James, chief engineer of the Kern County Land Company, is located at what is known as "first point of measurement," 5 miles above Bakersfield and at the mouth of the canyon of the river.

Regular meter measurements are taken, and an automatic gage records daily fluctuations of the river heights. A. K. Warren, the engineer in charge of this work for the Kern County Land Company, attends to the discharge measurements with accuracy and precision and furnishes the Geological Survey with the final results. Information in regard to this station is contained in Water-Supply Papers Nos. 81, 85, 100, 134, and 177 of the United States Geological Survey.

Daily discharge, in second-feet, of Kern River near Bakersfield, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	242	529	854	2,980	2,846	5,415	7,369	3,552	1,522	697	546	518
2	253	513	806	2,651	2,798	5,353	7,765	3,282	1,438	705	570	517
3	230	506	779	2,424	2,986	5,306	8,251	3,236	1,369	695	566	542
4	233	509	795	2,291	3,337	5,495	8,431	3,147	1,297	677	554	575
5	241	529	842	2,172	3,786	5,964	8,246	2,953	1,255	680	550	545
6	246	538	777	2,051	4,434	5,126	8,129	2,905	1,201	687	580	506
7	253	560	765	2,010	4,608	5,788	7,973	2,880	1,167	622	555	530
8	256	580	755	1,970	5,278	5,932	7,729	2,852	1,111	618	528	552
9	260	646	785	2,135	6,097	5,311	7,607	2,769	1,064	634	539	587
10	265	578	851	2,296	6,782	5,797	7,257	2,627	1,039	639	516	676
11	269	589	896	2,302	5,624	7,213	7,176	2,536	1,030	645	499	675
12	267	510	1,026	2,278	6,133	8,190	7,211	2,548	983	647	502	654
13	272	568	1,996	2,336	5,687	8,829	7,072	2,473	938	649	518	677
14	1,626	538	1,945	2,484	5,640	9,079	5,705	2,377	919	631	520	653
15	1,828	574	1,716	2,635	5,886	9,072	5,628	2,275	916	612	529	601
16	1,293	684	5,264	2,767	6,079	9,142	6,719	2,211	891	613	514	589
17	890	701	5,527	2,898	6,055	9,004	6,603	2,215	883	592	462	587
18	687	661	3,025	3,032	6,348	8,819	5,254	2,206	883	564	446	584
19	1,370	646	2,106	3,178	5,868	8,993	6,093	2,097	839	554	476	562
20	2,554	655	1,807	3,343	7,339	9,375	5,870	2,215	807	555	468	556
21	1,145	717	1,725	3,597	7,443	9,505	5,439	2,192	809	564	433	552
22	931	785	1,854	3,911	7,381	9,505	4,997	2,071	806	560	450	560
23	807	739	1,978	4,135	7,025	9,311	5,648	1,840	788	558	474	556
24	746	681	2,284	4,255	5,492	9,107	5,920	1,662	785	564	462	550
25	698	665	3,417	3,853	6,184	8,918	5,595	1,540	781	559	440	562
26	666	710	3,983	3,698	7,660	8,668	5,347	1,446	777	562	446	592
27	643	735	4,150	3,598	7,832	8,187	5,392	1,405	755	568	478	948
28	616	773	3,195	3,692	7,420	7,529	5,269	1,435	731	557	479	914
29	602	....	2,701	3,347	6,825	7,143	4,659	1,467	715	553	487	802
30	551	....	2,527	2,973	6,102	7,010	4,311	1,434	704	564	502	732
31	548	....	2,818	....	5,646	....	3,925	1,431	....	565	....	697

Monthly discharge of Kern River near Bakersfield, Cal., for 1906.

[Drainage area, 2,345 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	2,554	230	693	42,600	0.296	0.34
February	785	506	626	34,800	.267	.28
March	5,527	755	2,063	127,000	.880	1.01
April	4,255	1,970	2,910	173,000	1.24	1.38
May	7,832	2,798	5,859	360,000	2.50	2.88
June	9,505	5,306	7,704	458,000	3.29	3.67
July	8,431	3,925	6,503	400,000	2.77	3.19
August	3,552	1,405	2,299	141,000	.980	1.13
September	1,522	704	973	57,900	.415	.46
October	705	553	609	37,400	.260	.30
November	580	433	503	29,900	.215	.24
December	948	506	618	38,000	.264	.30
The year	9,505	230	2,613	1,900,000	1.11	15.18

TULE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Tule River rises in the Sierra Nevada, and drains the country between Kaweah River on the north and Kern River on the south and east. Its drainage area is much less than that of Keweah River, although of the same general character. It has numerous small tributaries, few of which have their source at elevations above 8,000 feet. Its drainage basin does not extend back to the main divide, being cut off by Kern River, which reaches to the north and drains the higher portion of Sierra Nevada east of Tule River. There is good timber and brush covering on the higher and middle elevations, with grass and scattering timber on the lower elevations, where the soil is extensively cultivated. Below the gaging station the water is diverted by several canals and used for the irrigation of land in the vicinity of Portersville, where it is especially adapted for the raising of citrus fruits. During the flood period the water discharges through an old channel, and either sinks in the sand or finds its way to the old bed of Tulare Lake. The mean precipitation is probably not more than 20 inches, and falls principally in the form of rain.

TULE RIVER NEAR PORTERSVILLE, CAL.

This station was established April 8, 1901. It is located about 8 miles east of Portersville, near the McFarland ranch, 100 feet below wagon bridge and about 1 mile above the mouth of South Fork of Tule River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 189, where are given also references to publications that contain data for previous years.

Discharge measurements of Tule River near Portersville, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 15	C. H. Lee	76	144	3.02	429
March 28	do	83	206	4.42	1,210
May 10	do	80	264	4.20	1,000
May 24	R. S. Hawley	80	211	3.62	602
May 26	C. H. Lee	159	607	6.75	2,950
June 1	do	88	287	4.65	1,240
June 8	do	84	251	4.10	909
June 22	R. S. Hawley	86	278	4.40	1,090
July 20	do	73	132	2.65	284
July 26	C. H. Lee	69	112	2.30	222
September 27	R. S Hawley	59	46	1.40	56
November 15	do	58	47	1.40	59
November 24	do	58	47	1.44	62

Daily gage height, in feet, of Tule River near Portersville, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.0	2.4	4.8	3.6	4.6	3.7	2.05	1.5	1.3	1.4	1.45
2	2.07	2.0	2.4	4.6	3.6	4.6	3.8	2.0	1.5	1.3	1.4	1.45
3	2.0	2.0	2.4	4.0	3.7	4.4	3.7	1.95	1.5	1.3	1.4	1.45
4	1.9	2.0	3.6	3.8	3.8	4.2	3.6	1.95	1.45	1.3	1.4	1.45
5	1.9	2.0	3.2	3.8	4.0	4.1	3.5	1.9	1.45	1.3	1.4	1.5
6	1.9	2.0	3.1	4.4	3.9	4.0	3.55	1.9	1.45	1.3	1.4	1.5
7	1.87	2.0	3.0	4.0	3.9	4.0	3.5	1.85	1.45	1.3	1.4	1.5
8	1.85	2.2	2.9	3.6	4.1	4.1	3.2	1.85	1.45	1.3	1.4	1.6
9	1.83	2.15	2.8	3.6	4.1	4.2	3.2	1.8	1.4	1.3	1.4	1.65
10	1.8	2.1	2.7	3.8	4.4	4.3	3.15	1.8	1.4	1.3	1.4	2.0

Daily gage height, in feet, of Tule River near Portersville, Cal., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
11	1.8	2.05	2.7	3.8	4.4	4.4	3.1	1.8	1.4	1.3	1.4	2.6
12	2.0	2.0	6.6	3.6	4.5	4.5	3.0	1.75	1.4	1.3	1.4	2.4
13	5.65	2.0	5.7	3.6	4.25	4.4	2.9	1.7	1.4	1.3	1.4	2.0
14	7.35	2.0	4.2	3.6	4.0	4.3	2.85	1.7	1.4	1.3	1.4	1.8
15	3.85	3.1	8.35	3.6	4.0	4.35	2.8	1.65	1.4	1.3	1.4	1.5
16	3.3	2.8	8.5	3.6	4.1	4.3	2.75	1.65	1.4	1.3	1.4	1.65
17	3.0	2.7	7.0	3.6	4.1	4.35	2.75	1.6	1.4	1.3	1.4	1.65
18	2.8	2.6	5.0	3.6	4.1	4.3	2.7	1.6	1.35	1.3	1.4	1.65
19	7.0	2.5	4.5	3.6	4.1	4.35	2.7	1.6	1.35	1.3	1.4	1.65
20	4.1	2.5	4.2	3.7	4.0	4.35	2.65	1.55	1.35	1.3	1.45	1.65
21	3.3	2.7	4.2	3.8	3.9	4.3	2.6	1.55	1.35	1.3	1.45	1.65
22	2.9	2.65	4.2	4.0	3.8	4.4	2.5	1.55	1.35	1.3	1.45	1.65
23	2.7	2.6	4.2	4.25	3.7	4.3	2.45	1.55	1.35	1.35	1.45	1.65
24	2.5	2.5	5.4	4.0	3.65	4.2	2.4	1.55	1.4	1.35	1.45	1.65
25	2.4	2.45	6.0	3.7	3.6	4.0	2.35	1.55	1.45	1.35	1.45	1.65
26	2.3	2.4	7.25	3.6	6.4	3.95	2.3	1.55	1.4	1.35	1.45	2.3
27	2.2	2.4	5.2	3.4	6.55	3.9	2.25	1.5	1.4	1.35	1.45	2.1
28	2.15	2.4	4.5	4.6	6.5	3.7	2.25	1.5	1.35	1.35	1.45	2.0
29	2.1	......	4.3	3.8	5.4	3.7	2.2	1.5	1.35	1.35	1.45	1.95
30	2.05	......	4.3	3.7	5.0	3.7	2.15	1.5	1.3	1.35	1.45	1.9
31	2.03	......	5.4	......	4.7	......	2.1	1.5		1.35	......	1.9

Rating table for Tule River near Portersville, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	37	2.20	170	3.10	420	4.00	840	5.80	2,140
1.40	47	2.30	190	3.20	460	4.20	960	6.00	2,300
1.50	58	2.40	210	3.30	500	4.40	1,090	6.20	2,460
1.60	70	2.50	235	3.40	540	4.60	1,230	6.40	2,640
1.70	83	2.60	260	3.50	580	4.80	1,370	6.60	2,820
1.80	98	2.70	285	3.60	630	5.00	1,510	6.80	3,000
1.90	115	2.80	315	3.70	680	5.20	1,660	7.00	3,180
2.00	132	2.90	345	3.80	730	5.40	1,820	8.00	4,080
2.10	150	3.00	380	3.90	780	5.60	1,980	9.00	4,980

NOTE.—This table is based on discharge measurements made during 1904–1906, and is well defined between gage heights 2.2 feet and 6.7 feet.

Monthly discharge of Tule River near Portersville, Cal., for 1906.

[Drainage area, 437 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	3,500	98	500	30,700	1.14	1.31
February	420	132	200	11,100	.458	.48
March	4,530	210	1,370	84,200	3.14	3.62
April	1,370	540	772	45,900	1.77	1.98
May	2,780	630	1,080	66,400	2.47	2.85
June	1,230	680	972	57,800	2.22	2.48
July	730	150	362	22,300	.828	.95
August	141	58	84.3	5,180	.193	.22
September	58	37	47.4	2,820	.108	.12
October	42	37	38.5	2,370	.088	.10
November	52	47	48.8	2,900	.112	.12
December	260	52	97.1	5,970	.222	.26
The year	4,530	37	464	338,000	1.06	14.49

NOTE.—Values are rated as follows: January, February, and July, good; March to June, excellent; August to December, fair.

MISCELLANEOUS MEASUREMENTS IN THE TULE RIVER DRAINAGE BASIN.

The following miscellaneous measurements were made on South Fork of Tule River at a point one-half mile above the junction of South Fork with main Tule River:

May 26: Width, 40 feet; area, 100 square feet; discharge, 644 second-feet.
July 26: Width, 25 feet; area, 35 square feet; discharge, 64 second-feet.

KAWEAH RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kaweah River drains the western slope of the Sierra Nevada between the basins of Kings River on the north and Kern and Tule rivers on the south. This is an important stream, but its watershed is only about one-third that of Kings River and is much less elevated and snow covered than those of the Kings and Kern rivers. It has a number of tributaries which have their sources in numerous lakes and meadows on the higher elevations. The formation is of granite and similar in every way to that in the Kings River basin. The greater part of the area of 619 square miles above the gaging station is well covered with brush and timber. In this basin is situated the Sequoia National Park, where the largest grove of big trees (*Sequoia gigantea*) of the Sierra Nevada is found. Two power plants on this stream owned by the Mount Whitney Power Company, divert water from Middle and East forks. By building low dams at the outlet of some of the larger lakes, in the upper reaches of the basin, this company has constructed several small reservoirs, in which the water held back for use during the low-water flow of the stream, and is of great benefit to irrigators in the valley during the late summer months. About 6 miles below the gaging station the river leaves the foothills and flows across San Joaquin Valley in a general southwesterly direction to the old bed of Tulare Lake. After it leaves the foothills many canals divert water for the purpose of irrigating land in Tulare County, which is especially adapted to the raising of fruits.

The mean annual precipitation in the basin above the gaging station is from 20 to 40 inches, which falls in the form of snow over probably one-half the area.

KAWEAH RIVER BELOW THREE RIVERS, CAL.

This station was established April 29, 1903. It is located at a point three-fourths of a mile below the confluence of the North, Middle, and South forks, 10 miles from the Southern Pacific Railroad station at Lemon Cove, Tulare County, Cal., and one-fourth mile west of the wagon road from Exeter to Three Rivers. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 192, where are given also references to publications that contain data for previous years.

Discharge measurements of Kaweah River below Three Rivers, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 16	C. H. Lee	156	491	6.00	644
March 29	do	174	653	7.35	2,090
May 11	do	183	888	8.35	3,780
May 23	R. S. Hawley	180	814	7.80	2,690
May 28	C. H. Lee	200	1,050	9.20	5,280
May 31	do	182	837	8.00	3,180
June 9	do	186	896	8.40	3,640
June 20	R. S. Hawley	200	1,050	9.10	5,680
June 20	do	198	1,010	8.95	5,290
June 21	do	202	1,080	9.25	5,930
June 29	do	185	896	8.25	3,470
July 19	do	179	798	7.65	2,480
July 28	C. H. Lee	170	676	7.10	1,700
September 26	R. S. Hawley	146	332	4.97	148
November 14	do	142	293	4.72	98

Daily gage height, in feet, of Kaweah River below Three Rivers, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.55	5.3	5.85	7.8	6.95	8.05	8.8	6.65	5.5	4.9	4.7	4.8
2	4.5	5.3	5.75	7.6	7.05	8.0	9.1	6.8	5.45	4.9	4.7	4.8
3	4.6	5.3	5.85	7.4	7.2	8.15	9.1	......	5.4	4.9	4.7	4.8
4	4.6	5.3	6.45	7.3	7.45	8.1	9.05	6.4	5.4	4.9	4.75	5.0
5	4.6	5.3	5.95	7.05	7.6	8.25	9.0	6.5	5.35	4.9	5.06	4.9
6	4.6	5.3	5.95	7.1	7.55	8.0	9.0	6.45	5.3	4.85	4.85	4.9
7	4.6	5.3	5.95	6.95	7.8	7.95	8.8	6.45	5.25	4.8	4.8	4.9
8	4.6	5.4	6.0	6.9	8.2	8.3	8.8	6.4	5.3	4.8	4.8	4.9
9	4.6	5.45	6.0	7.0	8.35	8.65	8.6	6.4	5.3	4.8	4.75	5.3
10	4.6	5.4	6.05	7.35	8.35	8.85	8.55	6.3	5.3	4.75	4.75	5.1
11	4.6	5.4	6.05	7.1	8.25	9.1	8.5	6.3	5.25	4.75	4.7	5.0
12	4.7	5.35	9.3	6.95	8.0	9.25	8.5	6.2	5.2	4.75	4.7	5.7
13	8.1	5.3	7.9	7.0	7.75	9.1	8.4	6.15	5.1	4.75	4.7	5.25
14	9.25	5.4	7.05	7.05	7.8	9.1	8.4	6.1	5.15	4.7	4.7	5.1
15	6.55	6.3	10.3	7.05	7.75	9.1	8.35	6.1	5.15	4.7	4.7	5.1
16	5.95	6.0	10.1	7.15	7.9	9.25	8.3	6.1	5.2	4.7	4.7	5.0
17	5.7	5.8	8.75	7.15	8.15	9.1	8.2	6.0	5.1	4.7	4.7	5.0
18	6.3	5.7	7.85	7.15	8.3	9.1	7.95	6.0	5.05	4.7	4.7	5.0
19	9.3	5.7	7.35	7.25	8.35	9.45	7.8	6.0	5.0	4.7	4.7	4.95
20	6.7	5.7	7.15	7.45	8.3	9.4	7.7	5.9	5.0	4.7	4.7	4.95
21	6.15	6.25	7.25	7.6	8.2	9.5	7.6	5.8	5.0	4.7	4.7	4.95
22	5.85	5.9	7.15	7.6	8.1	9.35	7.75	5.75	5.0	4.7	4.7	5.0
23	5.7	5.75	7.05	7.8	7.75	9.35	7.85	5.65	4.95	4.7	4.75	5.0
24	5.6	5.7	8.05	7.45	7.6	9.35	7.7	5.6	5.0	4.7	4.75	5.0
25	5.6	5.7	8.7	7.25	8.05	9.15	7.6	5.6	5.0	4.7	4.75	5.0
26	5.5	5.7	8.6	7.15	9.45	8.9	7.6	5.55	4.95	4.7	4.8	6.5
27	5.5	5.7	8.2	7.35	8.5	8.55	7.5	5.5	4.9	4.7	4.75	5.75
28	5.4	6.15	7.95	7.45	9.75	8.4	7.4	5.5	4.9	4.7	4.75	5.8
29	5.4	......	7.4	7.15	8.45	8.45	7.05	5.5	4.9	4.65	4.8	5.4
30	5.4	......	7.65	7.0	8.2	8.65	6.9	5.5	4.9	4.65	4.7	5.3
31	5.3	......	8.35	......	8.1	......	6.8	5.6	......	4.7	......	5.45

Rating table for Kaweah River below Three Rivers, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.50	75	5.40	312	6.30	840	7.20	1,830	8.20	3,420
4.60	91	5.50	350	6.40	930	7.30	1,960	8.40	3,800
4.70	109	5.60	395	6.50	1,020	7.40	2,100	8.60	4,180
4.80	130	5.70	445	6.60	1,120	7.50	2,240	8.80	4,590
4.90	154	5.80	500	6.70	1,220	7.60	2,400	9.00	5,040
5.00	180	5.90	560	6.80	1,340	7.70	2,560	9.20	5,520
5.10	210	6.00	625	6.90	1,460	7.80	2,720	9.40	6,000
5.20	240	6.10	690	7.00	1,580	7.90	2,880	9.60	6,480
5.30	274	6.20	760	7.10	1,700	8.00	3,060	9.80	6,960

NOTE.—This table is based upon 15 discharge measurements made during 1906 and is well defined below gage height 9.2 feet. Above gage height 9 feet the rating curve is a tangent, the difference being 240 per tenth.

Monthly discharge of Kaweah River below Three Rivers, Cal., for 1906.

[Drainage area, 520 square miles.]

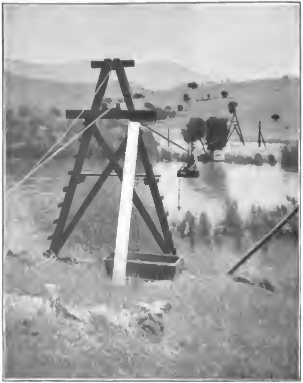
Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	5,760	75	784	48,200	1.51	1.74
February	840	274	418	23,200	.804	.84
March	8,160	472	2,440	150,000	4.69	5.41
April	2,720	1,460	1,910	114,000	3.67	4.10
May	6,840	1,520	3,210	197,000	6.17	7.11
June	6,240	2,970	4,670	278,000	8.98	10.02
July	5,280	1,340	3,430	211,000	6.60	7.61
August	1,340	350	691	42,500	1.33	1.53
September	350	154	226	13,400	.435	.49
October	154	100	120	7,380	.231	.27
November	195	109	119	7,080	.229	.26
December	1,020	109	245	15,100	.471	.54
The year	8,160	75	1,520	1,110,000	2.93	39.92

NOTE.—These values are excellent.

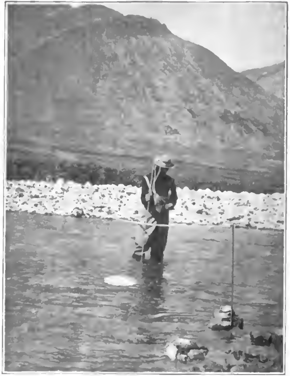
KINGS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Kings River rises on the western slope of the Sierra Nevada and drains the country located between San Joaquin River on the north and Kaweah and Kern rivers on the south. The Sierra Nevada at the head of this basin reaches elevations of over 14,000 feet and comprises the most rugged portion of the range; the sharp and precipitous peaks produce the grandest scenery to be found in the United States. The main tributaries of this stream flow through great canyons with high precipitous walls cut in the granite. The Kings River Canyon on South Fork and Tehipite Valley on Middle Fork rival the famed Yosemite Valley for grandeur of scenery. There are numerous tributaries, many of which have their sources in perpetual snow banks on the higher elevations. A large number of small lakes on the higher elevations are fed by small streams from perpetual snow banks or glaciers, and in them many of the tributaries have their source.



A. CABLE STATION, KINGS RIVER, NEAR RED MOUNTAIN, CALIFORNIA.



B. DISCHARGE MEASUREMENT BY WADING.

The formation is of granite, which above an elevation of 10,000 feet is bare, with scanty vegetation, being carved by the action of glaciers; below the 10,000-foot contour is a heavy covering of timber and underbrush. Extensive groves of big trees are scattered throughout this basin. On the lower elevations along the foothills the soil covering is light with a grass growth used for pasturage. Fully 80 per cent of the drainage area is now included in the boundaries of the Sierra Forest Reserve, which is patrolled for the prevention of fires and illegal herding. Below the gaging station, which is located at the point where the river leaves the foothills, canals divert the water for use in the valley lands of Fresno, Kings, and Tulare counties, where the climate and soil are especially adapted to the raising of grapes, fruits, etc., and the soil is under a high state of cultivation. During the period of flood discharge some water passes these canals and finds its way across Kings River delta in the natural channel to the old bed of Tulare Lake, which is now but an intermittent lake due largely to the diversion of water for irrigation purposes from the streams which drain into it. The drainage area above the Red Mountain gaging station is 1,742 square miles. The mean annual precipitation for this area varies from about 30 to 60 inches, which over a greater portion of the basin falls in the form of snow. The greater discharge of this stream is in the spring months when the snow is melting. (See Pl. III, *A*.)

KINGS RIVER NEAR SANGER, CAL.

This station was established September 3, 1895. It is located 15 miles east of Sanger, Cal., near the mouth of the canyon, and is above all diversions. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 196, where are given also references to publications that contain data for previous years.

Discharge measurements of Kings River near Sanger, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 30	C. H. Lee	164	564	5.20	966
March 30	do	289	1,200	8.20	4,380
May 12	do	320	2,060	10.80	10,500
May 22	R. S. Hawley	320	2,190	11.15	12,600
May 27	C. H. Lee	320	2,040	10.70	10,400
June 2	do	312	1,800	9.90	8,200
June 19	R. S. Hawley	358	2,880	13.10	21,600
July 18	do	322	2,280	11.40	13,200
July 27	C. H. Lee	317	2,240	11.20	11,800
September 25	R. S. Hawley	172	496	5.18	768
October 18	do	150	398	4.75	472
November 13	do	149	375	4.63	398

Daily gage height, in feet, of Kings River near Sanger, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.25	5.1	5.85	9.35	8.05	10.0	12.85	9.8	6.6	5.05	4.6	4.5
2	3.9	5.1	5.7	8.5	8.3	9.95	12.95	9.8	6.45	5.05	4.65	4.55
3	3.9	5.1	5.8	8.15	8.75	10.15	13.1	9.8	6.35	5.05	4.65	4.55
4	4.0	5.1	6.5	7.9	9.3	10.15	13.25	9.8	6.3	5.05	4.65	4.6
5	4.05	5.1	6.5	7.7	9.8	10.95	13.1	9.1	6.2	5.05	4.95	4.65
6	4.1	5.1	6.2	7.55	9.85	10.35	13.0	9.2	6.1	5.0	4.8	4.65
7	4.1	5.1	6.2	7.4	10.2	10.25	12.6	9.2	5.95	4.95	4.75	4.65
8	......	5.1	6.3	7.4	10.7	10.75	12.7	9.2	5.85	4.95	4.7	4.65
9	4.0	5.2	6.35	7.6	11.0	11.45	12.7	8.8	5.9	4.9	4.7	4.85
10	4.0	5.3	6.4	8.1	11.2	11.95	12.6	8.6	5.9	4.9	4.7	4.85
11	4.0	5.5	6.45	8.15	11.4	12.5	12.8	8.9	5.85	4.85	4.65	4.85
12	4.05	5.2	9.7	7.85	10.9	12.85	12.7	8.4	5.75	4.85	4.65	5.25
13	7.3	5.1	10.9	7.9	10.25	12.8	12.8	8.4	5.65	4.8	4.6	5.1
14	11.4	5.2	8.4	8.1	10.6	12.6	12.6	8.3	5.55	4.8	4.6	4.9
15	7.0	6.75	10.7	8.1	10.65	12.7	12.9	8.25	5.5	4.8	4.6	4.85
16	6.2	6.25	13.0	8.4	10.7	12.9	12.6	8.2	5.45	4.75	4.6	4.8
17	5.85	5.85	10.35	8.4	10.8	13.0	12.3	8.0	5.4	4.75	4.6	4.8
18	8.5	5.65	9.15	8.5	11.2	13.0	11.5	8.0	5.3	4.75	4.6	4.8
19	13.8	5.65	8.25	8.75	11.4	13.3	11.5	7.9	5.2	4.75	4.6	4.75
20	8.1	5.7	7.90	9.1	11.5	14.0	11.4	7.65	5.15	4.7	4.5	4.75
21	6.85	6.05	8.00	9.4	11.4	13.8	11.15	7.6	5.15	4.7	4.5	4.75
22	6.4	6.2	8.05	9.45	11.2	13.5	11.2	7.25	5.15	4.7	4.55	4.75
23	6.1	6.05	8.10	9.75	11.05	13.3	11.4	6.9	5.15	4.65	4.55	4.75
24	5.75	5.9	9.35	9.1	10.55	13.4	11.4	6.7	5.15	4.7	4.5	4.75
25	5.7	5.75	10.35	8.65	10.5	13.4	11.4	6.55	5.15	4.65	4.5	4.85
26	5.65	5.8	10.45	8.55	12.0	12.8	11.2	6.5	5.15	4.65	4.55	6.8
27	5.6	5.8	9.50	8.75	11.45	12.1	11.1	6.5	5.1	4.65	4.55	6.3
28	5.5	6.0	8.70	9.15	12.2	11.6	10.85	6.5	5.05	4.65	4.55	6.45
29	5.3	......	8.25	8.5	11.6	11.7	10.55	6.45	5.05	4.65	4.55	5.7
30	5.2	......	8.15	8.1	10.15	12.3	10.05	6.45	5.05	4.6	4.55	5.35
31	5.15	......	9.40	......	9.95	......	9.9	6.7	......	4.6	......	5.9

NOTE.—These gage heights were taken from an automatic river stage register, except June 15 to 30, when the instrument was out of use, and the readings are from the staff gage. The mean daily gage height is determined from the register sheets by the use of a planometer.

Rating table for Kings River near Sanger, Cal.

JANUARY 1 TO JUNE 30, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.90	205	5.00	740	6.10	1,550	7.40	2,965	9.60	7,360
4.00	240	5.10	805	6.20	1,640	7.60	3,240	9.80	7,900
4.10	280	5.20	870	6.30	1,730	7.80	3,535	10.00	8,470
4.20	325	5.30	940	6.40	1,820	8.00	3,850	11.00	11,700
4.30	370	5.40	1,010	6.50	1,920	8.20	4,190	12.00	15,900
4.40	420	5.50	1,085	6.60	2,020	8.40	4,570	13.00	21,040
4.50	470	5.60	1,160	6.70	2,120	8.60	4,980	14.00	26,600
4.60	520	5.70	1,235	6.80	2,230	8.80	5,410		
4.70	570	5.80	1,310	6.90	2,340	9.00	5,860		
4.80	625	5.90	1,390	7.00	2,460	9.20	6,330		
4.90	680	6.00	1,470	7.20	2,705	9.40	6,840		

JULY 1 TO DECEMBER 31,1906.[b]

4.50	330	4.90	575	5.30	870	5.70	1,190	6.00	1,460
4.60	385	5.00	645	5.40	950	5.80	1,280	6.10	1,550
4.70	445	5.10	720	5.50	1,030	5.90	1,370		
4.80	510	5.20	795	5.60	1,110				

[a] This table is based on discharge measurements made during 1895-1906 and is well defined.

[b] This table is based on 3 discharge measurements made during 1906 and is well defined. Above gage height 6.1 feet it is the same as the previous table.

Monthly discharge of Kings River near Sanger, Cal., for 1906.

[Drainage area, 1,740 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	25,500	205	2,360	144,000	1.36	1.57
February	2,150	792	1,150	63,900	0.661	.69
March	21,000	1,220	5,240	322,000	3.01	3.47
April	7,760	2,960	4,720	281,000	2.71	3.02
May	16,800	3,930	10,700	658,000	6.15	7.09
June	26,600	8,320	17,100	1,020,000	9.83	11.00
July	22,400	8,180	16,300	1,000,000	9.37	10.80
August	7,900	1,870	4,300	264,000	2.47	2.85
September	2,020	682	1,120	66,600	0.644	.72
October	682	385	516	31,700	0.297	.34
November	610	330	397	23,600	0.228	.25
December	2,230	330	700	43,000	0.402	.46
The year	26,600	205	5,380	3,920,000	3.09	42.26

NOTE.—Values are rated as excellent; discharges for September to December are based on 3 measurements which indicate a greater change in conditions of flow than had taken place in ten years previously, but they are believed to be accurate.

MERCED RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Merced River drains that portion of the western slope of the Sierra Nevada located between Tuolumne River on the north and San Joaquin River on the south. Its drainage area is much less than that of Tuolumne River. It has numerous tributaries, several of which are of considerable size.

The topography of the country in this basin is similar to that of Tuolumne River, being rough and broken in the upper reaches. In this basin is situated the famous Yosemite Valley, with its precipitous walls and domes and great waterfalls, which occur on the main stream and its tributaries, which discharge into the valley over precipitous cliffs rising 2,000 to 3,000 feet above the floor of the valley. The formation is of granite, which on the upper reaches of the basin above Yosemite Valley is bare, rising in precipitous peaks and domes, and is smoothly marked by glacial action. The middle reaches of the basin are well timbered. The Mariposa grove of big trees is situated in the basin of the South Fork. The timber growth extends well down on the lower elevations to the foothills, where the covering is of brush and grass, used extensively for pasturage. Numerous lakes are scattered over the upper portion of the basin. The mean annual precipitation varies from 25 inches in the foothills to 60 inches on the higher elevations, where it falls in the form of snow, which melts in the spring months, except on the extreme higher mountain peaks, where it often remains during the entire year. After leaving the foothills at Merced Falls, where the gaging station is located, canals divert the water for irrigation on lands along the river bottom and in San Joaquin Valley. The surplus water during flood discharge enters San Joaquin River.

MERCED RIVER ABOVE MERCED FALLS, CAL.

The measurement of Merced River was undertaken in response to numerous requests from mining and irrigation interests, the midsummer flow being less than the combined capacity of the irrigation and power canals taking water in the vicinity of Snelling. The station was established April 6, 1901. It is located 1 mile above Merced Falls. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 203, where are given also references to publications that contain data for previous years.

Discharge measurements of Merced River above Merced Falls, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 27	C. H. Lee	143	380	9.40	710
February 17	do	146	406	9.50	833
March 31	do	321	1,900	14.80	12,700
March 31	do	317	1,800	14.50	11,000
April 1	do	305	1,360	13.20	7,680
April 26	R. S. Hawley	268	760	11.42	3,000
May 16	C. H. Lee	287	1,140	12.60	5,660
May 27	W. C. Sawyer	301	1,270	13.15	6,960
May 28	do	353	2,320	16.40	17,300
May 28	do	350	2,270	16.20	16,000
May 28	do	348	2,160	16.00	15,200
May 28	do	347	2,160	15.90	14,900
June 6	do	285	1,030	12.42	4,860
June 16	do	318	1,640	14.50	11,000
June 22	do	325	1,670	14.75	11,000
June 30	do	306	1,240	13.48	7,270
July 12	do	289	1,140	13.56	6,350
July 13	do	303	1,210	13.68	6,980
July 20	do	250	875	12.15	4,210
July 21	do	247	846	11.85	4,040
August 2	do	180	543	10.38	1,510
August 4	do	180	522	10.30	1,430
August 5	do	180	527	10.24	1,350
August 19	W. F. Martin	168	428	9.85	917
September 6	do	142	292	8.90	322
November 20	do	130	224	8.42	145

Daily gage height, in feet, of Merced River above Merced Falls, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.1	9.0	10.35	13.05	11.35	12.4	14.0	10.55	9.1	8.35	8.3	8.4
2	8.1	9.0	10.15	12.15	11.55	12.45	14.2	10.5	9.1	8.35	8.3	8.35
3	8.05	9.0	10.05	11.7	11.75	12.65	14.35	10.45	9.0	8.4	8.3	8.35
4	8.0	9.0	11.3	11.45	12.15	12.65	14.35	10.35	9.0	8.4	8.3	8.3
5	8.0	9.0	10.7	11.25	12.45	13.15	14.3	10.25	8.95	8.45	8.5	8.4
6	8.05	9.0	10.5	11.0	12.75	12.55	14.15	10.15	8.9	8.4	8.7	8.35
7	8.05	9.0	10.2	11.0	13.0	12.25	14.05	10.15	8.9	8.35	8.55	8.3
8	8.0	9.0	10.15	10.85	13.15	12.7	14.05	10.15	8.9	8.4	8.5	8.35
9	8.05	9.05	10.1	10.95	13.2	13.1	13.9	10.15	8.9	8.4	8.45	8.4
10	8.15	9.1	10.1	11.25	13.5	13.35	13.5	10.15	8.8	8.4	8.4	8.5
11	8.05	9.25	10.15	11.45	13.85	13.95	13.55	10.3	8.8	8.4	8.4	9.75
12	8.15	9.1	13.25	11.15	13.35	14.4	13.6	10.15	8.75	8.3	8.4	11.65
13	10.55	9.0	12.8	11.05	12.75	14.65	13.4	9.95	8.8	8.3	8.4	9.6
14	13.45	9.05	11.7	11.15	12.75	14.0	13.3	9.9	8.75	8.3	8.4	9.05
15	10.55	9.95	16.7	11.15	12.8	14.05	13.05	9.8	8.75	8.3	8.4	8.9
16	10.3	9.9	13.55	11.3	12.7	14.4	12.8	9.75	8.7	8.3	8.4	8.8
17	10.8	9.5	12.2	11.35	12.6	14.7	12.65	9.75	8.7	8.3	8.4	8.75
18	13.85	9.4	11.5	11.3	12.95	14.15	12.4	9.65	8.6	8.35	8.3	8.65
19	16.9	9.75	11.1	11.45	13.3	14.55	12.2	9.8	8.6	8.35	8.4	8.65
20	11.55	9.65	10.85	11.6	13.3	14.8	11.85	9.85	8.5	8.3	8.4	8.65

Daily gage height, in feet, of Merced River above Merced Falls, Cal., for 1906—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	10.55	11.15	10.85	11.85	13.2	15.0	11.85	9.75	8.5	8.3	8.35	8.6
22	10.05	11.2	11.15	12.0	12.9	14.9	11.65	9.55	8.5	8.3	8.3	8.55
23	9.85	10.7	11.1	12.7	12.5	14.45	11.75	9.45	8.5	8.3	8.3	8.7
24	9.65	10.45	14.55	12.0	12.3	14.9	11.7	9.3	8.5	8.3	8.3	8.6
25	9.5	10.8	15.85	11.6	12.25	14.9	11.7	9.2	8.5	8.3	8.3	8.65
26	9.5	10.45	14.1	11.4	13.75	14.0	11.6	9.2	8.55	8.3	8.3	11.5
27	9.4	10.25	12.9	11.45	13.4	13.45	11.5	9.1	8.55	8.3	8.3	11.45
28	9.25	10.7	12.0	12.15	16.0	12.85	11.25	9.1	8.5	8.3	8.3	11.3
29	9.2	......	11.55	11.7	13.6	13.0	11.0	9.1	8.5	8.3	8.3	10.35
30	9.1	......	11.6	11.5	12.8	13.45	10.8	9.1	8.5	8.05	8.3	9.75
31	9.0	......	14.1	......	12.5	......	10.7	9.1	......	8.3	......	10.35

Rating tables for Merced River above Merced Falls, Cal.

JANUARY 1, 1905, TO JULY 31, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
8.00	90	9.00	465	10.00	1,240	11.00	2,545	13.00	6,630
8.10	115	9.10	520	10.10	1,345	11.20	2,870	13.20	7,130
8.20	140	9.20	580	10.20	1,455	11.40	3,215	13.40	7,630
8.30	170	9.30	645	10.30	1,570	11.60	3,570	13.60	8,150
8.40	200	9.40	715	10.40	1,690	11.80	3,945	13.80	8,670
8.50	235	9.50	790	10.50	1,820	12.00	4,340	14.00	9,200
8.60	275	9.60	870	10.60	1,955	12.20	4,755	15.00	12,050
8.70	315	9.70	955	10.70	2,095	12.40	5,200	16.00	15,300
8.80	360	9.80	1,045	10.80	2,240	12.60	5,665	17.00	18,800
8.90	410	9.90	1,140	10.90	2,390	12.80	6,140		

AUGUST 1 TO DECEMBER 3, 1906.[b]

8.00	55	8.80	280	9.60	750	10.40	1,510	11.40	3,140
8.10	70	8.90	320	9.70	820	10.50	1,650	11.60	3,520
8.20	90	9.00	370	9.80	890	10.60	1,800	11.80	3,930
8.30	115	9.10	425	9.90	970	10.70	1,960	12.00	4,340
8.40	140	9.20	480	10.00	1,060	10.80	2,120		
8.50	170	9.30	540	10.10	1,160	10.90	2,280		
8.60	205	9.40	610	10.20	1,260	11.00	2,440		
8.70	240	9.50	680	10.30	1,380	11.20	2,780		

[a] This table is based on discharge measurements made during 1905-6 and is well defined.

[b] This table is based on 7 discharge measurements made during August to November, 1906, and is well defined above gage height 8.4 feet. Above gage height 12 feet, the table is the same as the previous one.

Monthly discharge of Merced River above Merced Falls, Cal., for 1906.

[Drainage area, 1,090 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	18,400	90	1,840	113,000	1.69	1.95
February	2,870	465	1,060	58,900	.972	1.01
March	17,800	1,290	4,660	287,000	4.28	4.93
April	6,760	2,320	3,500	208,000	3.21	3.58
May	15,300	3,130	6,530	402,000	5.99	6.91
June	12,000	4,860	8,410	500,000	7.72	8.61
July	10,200	2,100	6,260	385,000	5.74	6.62
August	1,720	425	948	58,300	.870	1.00
September	125	170	254	15,100	.233	.26
October	155	62	122	7,500	.112	.13
November	240	115	135	8,030	.124	.14
December	3,620	115	735	45,200	.674	.78
The year	18,400	62	2,870	2,090,000	2.63	35.92

NOTE.—These values are excellent.

MERCED RIVER IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 11, 1904,. It is located at the wagon bridge, near the Sentinel Hotel. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 201, where are given also references to publications that contain data for previous years.

Discharge measurements of Merced River in Yosemite Valley, California, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 24	W. B. Clapp	95	668	6.80	1,760
November 8	C. W. Tucker	89	286	3.30	50

Daily gage height, in feet, of Merced River in Yosemite Valley, California, for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	6.0	9.4	6.2	4.3	3.5	3.3	3.2
2	....	6.1	9.5	6.0	4.3	3.5	3.3	3.2
3	....	6.75	9.8	6.0	4.2	3.6	3.3	3.2
4	....	6.8	9.5	5.8	4.2	3.6	3.4	3.2
5	....	7.4	9.6	5.7	4.1	3.5	3.5	3.2
6	....	6.45	9.5	5.6	4.1	3.5	3.3	3.2
7	....	6.5	9.5	5.6	4.1	3.6	3.3	3.2
8	....	7.0	9.1	5.6	4.0	3.5	3.3	3.2
9	....	7.8	9.1	5.6	4.0	3.5	3.3	3.2
10	....	8.0	8.7	5.7	4.0	3.5	3.3	3.2
11	....	9.55	8.6	5.8	4.0	3.4	3.3	3.2
12	....	9.5	8.8	5.6	3.9	3.4	3.3	....
13	....	9.6	9.0	5.4	3.9	3.5	3.3	....
14	....	9.2	8.8	5.3	3.9	3.4	3.3	....
15	....	9.1	8.3	5.2	3.9	3.4	3.3	....
16	....	10.0	8.5	5.1	3.8	3.4	3.3	....
17	....	9.5	8.3	5.1	3.7	3.3	3.3	....
18	....	9.2	7.8	5.4	3.7	3.4	3.3	....
19	....	9.8	7.7	5.5	3.6	3.3	3.3	....
20	....	9.8	7.8	5.2	3.6	3.3	3.3	....
21	....	10.0	7.7	4.9	3.5	3.3	3.3	....
22	....	9.9	7.8	4.8	3.6	3.3	3.3	....
23	7.00	9.8	7.8	4.5	3.6	3.3	3.3	....
24	6.75	9.8	7.8	4.4	3.6	3.3	3.3	....
25	6.80	10.0	7.7	4.4	3.6	3.3	3.3	....
26	6.8	8.8	8.1	4.4	3.6	3.3	3.2	....
27	6.3	8.4	7.4	4.4	3.5	3.3	3.2	....
28	6.1	7.8	7.1	4.4	3.5	3.3	3.2	....
29	5.7	8.0	6.7	4.4	3.5	3.3	3.2	....
30	5.7	8.4	6.4	4.3	3.5	3.2	3.2	....
31	5.7	....	6.4	4.3	....	3.2	....	....

YOSEMITE CREEK IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 9, 1904. It is located at the wagon bridge, about one-half mile from Yosemite, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 205, where are given also references to publications that contain data for previous years.

No measurements were made at this station during 1906. On November 12, with a gage height of 5 feet, there was no flow at the section.

Daily gage height, in feet, of Yosemite Creek, in Yosemite Valley, Cal., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		6.4	9.2	5.8	5.2	5.0	5.0	5.0
2		6.5	9.5	5.7	5.2	5.0	5.0	5.0
3		7.0	9.4	5.6	5.1	5.0	5.0	5.0
4		7.1	9.4	5.6	5.1	5.0	5.2	5.0
5		7.4	9.6	5.6	5.1	5.0	5.1	5.0
6		7.0	9.5	5.5	5.1	5.0	5.1	5.0
7		6.9	9.4	5.6	5.0	5.0	5.1	5.0
8		7.1	9.2	5.5	5.0	5.0	5.0	5.0
9		7.9	9.1	5.4	5.0	5.0	5.0	5.0
10		8.0	8.8	5.5	5.0	5.0	5.0	5.0
11		8.9	8.9	5.5	5.0	5.0	5.0	5.0
12		9.8	8.0	5.4	5.0	5.0	5.0	....
13		9.4	8.1	5.3	5.0	5.0	5.0	....
14		8.8	8.0	5.4	5.0	5.0	5.0	....
15		8.7	7.4	5.4	5.0	5.0	5.0	....
16		11.15	7.2	5.3	5.0	5.0	5.0	....
17		9.3	7.1	5.3	5.0	5.0	5.0	....
18		9.1	7.1	5.3	5.0	5.0	5.0	....
19		9.8	6.8	5.3	5.0	5.0	5.0	....
20		9.7	6.8	5.3	5.0	5.0	5.0	....
21		9.9	6.7	5.4	5.0	5.0	5.0	....
22		9.9	6.7	5.3	5.0	5.0	5.0	....
23	7.5	9.8	6.6	5.2	5.0	5.0	5.0	....
24	7.05	9.7	6.6	5.2	5.0	5.0	5.0	....
25	7.0	9.8	6.7	5.1	5.0	5.0	5.0	....
26	7.0	7.7	6.9	5.1	5.0	5.0	5.0	....
27	6.5	7.4	6.4	5.1	5.0	5.0	5.0	....
28	6.4	7.4	6.2	5.1	5.0	5.0	5.0	....
29	[a]9.0	7.4	5.9	5.1	5.0	5.0	5.0	....
30	6.0	7.7	5.7	5.1	5.0	4.9	5.0	....
31	6.1	....	6.0	5.1	....	4.9	....	....

[a] Backwater from snow.

NOTE.—There was practically no flow after September 1.

TENAYA CREEK IN YOSEMITE VALLEY, CALIFORNIA.

This station was established July 11, 1904. It is located by the wagon bridge, about 2 miles from Yosemite, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 207, where are given also references to publications that contain data for previous years.

The following measurement was made June 11, 1906.:

Width, 44 feet; area, 176 square feet; gage height, 720 feet; discharge, 891 second-feet.

Daily gage height, in feet, of Tenaya Creek in Yosemite Valley, Cal., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.6	7.1	4.6	3.5	3.0	3.0	3.0
2		5.7	7.2	4.4	3.4	3.0	3.0	3.0
3		6.0	7.3	4.5	3.4	3.0	3.0	3.0
4		6.0	7.2	4.4	3.3	3.0	3.2	3.0
5		6.3	7.2	4.3	3.2	2.9	3.2	3.0
6		6.0	7.1	4.4	3.2	2.9	3.1	3.0
7		6.1	7.2	4.4	3.1	2.9	3.1	3.0
8		6.3	7.1	4.3	3.0	2.9	3.0	3.0
9		6.7	7.0	4.3	3.0	2.9	3.0	3.0
10		6.8	6.7	4.4	3.0	2.9	3.0	3.0
11		6.9	6.6	4.3	3.0	2.9	3.0	3.0
12		6.9	7.0	4.2	2.9	2.9	3.0	....
13		7.0	7.1	4.2	3.0	2.9	3.0	....
14		7.1	7.0	4.1	3.0	3.0	3.0	....
15		7.4	6.5	4.1	3.1	3.0	3.0	....

Daily gage height, in feet, of Tenaya Creek in Yosemite Valley, Cal., for 1906—Cont'd.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16		8.1	6.3	4.0	3.0	2.0	3.0	
17		7.8	6.2	4.0	3.0	2.9	3.0	
18		7.3	6.1	3.0	3.0	3.0	3.0	
19		7.1	6.0	3.8	3.0	2.9	3.0	
20		7.5	5.8	3.9	3.0	2.9	3.0	
21		7.4	5.6	3.8	3.0	2.9	3.0	
22		7.3	5.5	3.8	3.0	2.0	3.0	
23		7.4	5.5	3.8	3.0	3.0	3.0	
24		7.4	5.4	3.7	3.0	2.0	3.0	
25	6.2	7.5	5.5	3.6	3.0	2.9	3.0	
26	6.1	6.1	5.7	3.6	3.0	2.9	3.0	
27	5.9	6.0	5.7	3.5	3.0	3.0	3.0	
28	5.7	6.4	5.2	3.5	3.0	2.0	3.0	
29	5.5	6.6	5.0	3.4	3.0	2.0	3.0	
30	5.5	6.9	4.7	3.4	3.0	3.0	3.0	
31	5.5		4.7	3.4		3.0		

TUOLUMNE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Tuolumne River rises on the western slope of the Sierra Nevada and drains the country located between Stanislaus River on the north and Merced River on the south. It has numerous tributaries, several of which produce a heavy discharge. The country throughout this basin is rough and rugged, especially along the main river, which cuts through solid granite, with high precipitous cliffs on either side. Along this stream is found some of the grandest scenery of the Sierra Nevada. This stream drains the northern portion of the Yosemite National Park, where is located the Grand Canyon of the Tuolumne and the Hetch Hetchy Valley, declared by many to exceed the famed Yosemite Valley in grandeur and beauty. The formation is of granite, which on the higher elevations is bare and glaciated, often rising thousands of feet in vertical cliffs and domes. Along the middle reaches of this basin there is good soil covering, with a heavy timber growth of pine, fir, cedar, and other kindred trees. On the lower reaches the covering is a heavy growth of brush, which diminishes in the foothills where the stream enters the San Joaquin Valley. This portion of the basin has a light soil covering, with grass growth, which is used for pasturage. There are several glacial lakes throughout the upper reaches of this basin, many of the larger of which offer exceptional opportunities for the construction of storage reservoirs. There are also many reservoir sites on the main river. The stream has a a heavy fall, and the opportunities for power development are numerous. Several diversions are made above the gaging station, which is located at Lagrange, where the stream breaks from the foothills. The precipitation on the upper half of this basin falls in the form of snow, a greater portion of which disappears in the spring months, but on the higher elevations much remains until late in the summer. The mean annual rainfall varies from about 30 inches on the lower foothills to about 60 inches on the higher elevations.

TUOLUMNE RIVER AT LA GRANGE, CAL.

This station was established August 29, 1895. It is located at the wagon bridge, in the town of La Grange. It is below the high dam, where the diversions are made by the Turlock and Modesto canals, and also below the head of the canal of the La Grange Ditch and Hydraulic Mining Company, which diverts water from the left bank of the river above the dam. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 209, where are given also references to publications that contain data for previous years.

Discharge measurements of Tuolumne River at La Grange, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 18	C. H. Lee	314	1,360	5.80	1,870
March 29	R. S. Hawley	342	2,000	7.71	6,220
April 25	do	337	2,000	7.52	5,710
May 15	C. H. Lee	348	2,550	8.80	11,000
May 25	W. C. Sawyer	330	2,140	8.18	7,760
May 28	do	370	2,970	10.45	15,900
June 4	do	348	2,500	9.11	11,100
June 14	do	380	2,810	10.10	14,800
June 21	do	384	3,050	10.54	17,000
June 29	do	342	2,360	8.62	9,750
July 3	do	376	3,000	10.79	18,300
July 11	do	366	2,610	9.00	11,800
July 21	do	340	2,230	8.22	8,570
July 31	do	331	1,790	6.80	4,150
August 3	do	326	1,580	6.20	2,700
August 6	do	320	1,440	5.78	1,890
August 20	W. F. Martin	318	1,360	5.43	1,380
November 21	do	298	983	4.26	197

Daily gage height, in feet, of Tuolumne River at La Grange, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.2	4.85	6.0	8.15	7.1	8.3	9.8	6.4	3.45	3.45	4.1	4.2
2	4.1	4.9	5.9	8.1	7.3	8.25	10.4	6.25	3.45	3.45	4.1	4.2
3	4.0	4.8	6.1	7.85	7.5	8.55	10.65	6.3	3.45	3.45	4.1	4.2
4	4.0	4.8	6.3	7.3	7.75	9.1	10.6	6.1	3.45	3.45	4.1	4.3
5	4.0	4.8	6.2	7.05	8.4	9.35	10.3	5.95	3.45	3.45	4.8	4.35
6	3.7	4.8	6.2	7.05	9.7	8.55	10.25	5.9	3.45	3.45	4.6	4.4
7	3.75	4.75	6.1	7.05	9.45	8.1	10.05	5.9	3.45	3.45	4.55	4.4
8	3.7	4.8	6.1	7.1	9.25	8.25	10.1	5.9	3.45	3.45	4.35	4.3
9	3.3	4.85	6.3	7.15	9.6	8.9	9.85	5.95	3.4	3.8	4.4	3.9
10	3.3	4.95	6.4	7.45	9.8	9.5	9.1	5.75	3.0	3.85	4.4	4.65
11	3.3	5.5	6.55	7.6	10.15	10.2	9.2	5.9	3.0	3.85	4.35	7.8
12	3.4	5.0	9.7	7.45	9.25	10.9	9.3	5.9	3.0	3.9	4.35	7.2
13	6.45	4.85	7.9	7.3	8.8	11.0	9.65	5.75	3.0	3.9	4.35	5.5
14	8.2	5.1	7.5	7.1	8.75	9.9	9.5	5.7	3.0	3.9	4.6	5.05
15	6.75	6.35	11.4	7.35	8.8	9.6	9.1	5.5	3.0	3.9	4.8	4.9
16	6.6	6.0	9.1	7.45	8.4	10.65	8.8	5.4	3.0	4.0	4.3	4.8
17	6.9	5.55	6.75	7.55	8.3	10.8	8.7	5.35	3.0	3.9	4.35	4.8
18	10.55	5.6	6.65	7.6	8.75	9.6	8.35	5.3	3.0	3.9	4.35	4.75
19	11.65	5.7	6.65	7.75	9.4	10.2	8.3	5.3	3.0	3.9	4.35	4.75
20	7.3	6.45	6.85	7.8	9.45	10.45	8.1	5.4	3.0	3.9	4.35	4.75
21	6.7	7.2	6.75	8.0	9.0	10.5	8.3	5.4	3.0	4.2	4.3	4.75
22	6.3	6.85	6.35	8.0	8.7	10.45	8.05	5.7	3.0	4.2	4.2	4.75
23	5.9	6.4	7.8	9.0	8.2	10.3	8.2	5.6	3.05	3.8	4.25	4.8
24	5.5	6.25	12.45	8.45	8.0	10.15	8.2	5.35	3.05	4.1	4.3	4.9
25	5.35	6.3	11.3	7.6	8.0	10.4	8.5	5.2	3.05	4.15	4.2	5.35
26	5.4	6.25	10.55	7.3	9.6	9.9	8.0	3.6	3.05	4.1	4.2	7.4
27	5.25	6.0	7.9	7.35	9.5	9.0	7.9	3.5	3.05	4.1	4.15	7.3
28	5.2	6.55	7.9	7.55	10.4	8.35	7.6	3.45	3.05	4.1	4.15	6.8
29	5.0	......	7.05	7.4	9.1	8.6	7.2	3.45	3.05	4.1	3.3	6.1
30	4.95	......	8.4	7.15	8.4	9.2	6.8	3.45	3.05	4.1	4.15	5.7
31	4.9	......	10.2	......	8.2	......	6.6	3.45	......	4.1	......	6.45

Rating table for Tuolumne River at La Grange, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	0	4.00	115	5.00	780	6.00	2,260	8.00	7,390
3.10	1	4.10	145	5.10	900	6.20	2,650	8.20	8,030
3.20	5	4.20	180	5.20	1,030	6.40	3,080	8.40	8,700
3.30	10	4.30	220	5.30	1,160	6.60	3,530	8.60	9,390
3.40	20	4.40	270	5.40	1,300	6.80	4,000	8.80	10,090
3.50	30	4.50	330	5.50	1,440	7.00	4,500	9.00	10,810
3.60	40	4.60	400	5.60	1,590	7.20	5,020	10.00	14,610
3.70	55	4.70	480	5.70	1,750	7.40	5,570	11.00	18,610
3.80	70	4.80	570	5.80	1,910	7.60	6,140		
3.90	90	4.90	670	5.90	2,080	7.80	6,750		

NOTE.—This table is based on 18 discharge measurements made during 1906 and earlier low water measurements, and is well defined.

Monthly discharge of Tuolumne River at La Grange, Cal., for 1906.

[Drainage area, 1,500 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft per sq. mile.	Depth in inches.
January	21,400	55	2,860	176,000	1.91	2.20
February	5,330	1,110	2,180	121,000	1.45	1.51
March	24,400	2,320	7,180	441,000	4.79	5.52
April	11,300	4,730	6,500	387,000	4.33	4.83
May	16,800	5,510	11,100	682,000	7.40	8.53
June	19,600	8,640	13,900	827,000	9.27	10.34
July	18,200	4,530	11,600	713,000	7.73	8.91
August	4,080	770	2,220	136,000	1.48	1.71
September	831	288	470	28,000	.313	.35
October	307	70	216	13,300	.144	.17
November	570	10	243	14,500	.162	.18
December	6,750	90	1,470	90,400	.980	1.13
The year	24,400	10	4,990	3,630,000	3.33	45.38

NOTE.—These discharges include those of Modesto and Turlock canals. Values are excellent, except those for Modesto canal for April, September, and October, which are classed as good, on account of the lack of measurements of the canal at low stages.

MODESTO CANAL AT LA GRANGE, CAL.

The Modesto canal is the property of the Modesto irrigation district. The water is diverted from the right side of Tuolumne River at the La Grange dam. This canal was designed to carry 660 second-feet and to irrigate land in the vicinity of Modesto, Stanislaus County, Cal. The principal part of the construction work was done on this canal prior to 1892, but on account of litigation the canal was not completed until April, 1903.

Information in regard to this station is contained in Water-Supply Papers Nos. 100, 134, and 177 of the United States Geological Survey.

During 1906 gagings were made about 500 feet below the intake at the La Grange dam. The canal at this point has a concrete section, the width being 20.2 feet at the bottom and the walls having a batter of about 1 to 5 outward. The floor of the canal is practically a plain surface, but the left side is 0.26 foot lower than the right side, where the highest velocity occurs. Measurements were made from the upper side of a plank footbridge. The gage is an iron bar 1½ by ¼ inches, graduated into feet and tenths and placed in a concrete well on the left side of the canal about 400 feet above the gaging station. The well is connected to the canal by means of a small pipe from the bottom at right angles to the canal wall.

Discharge measurements of Modesto canal at La Grange, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 16	C. H. Lee	22	59	2.80	395
June 5	W. C. Sawyer	21	43	2.11	302
June 5	do	21	39	1.91	257
June 8	do	21	58	2.79	393
June 8	do	21	56	2.70	412
June 29	do	22	70	2.66	387
July 2	do	21	69	2.60	380
July 11	do	21	70	2.60	383
July 19	do	21	68	2.52	376
August 6	Sawyer and Martin	21	66	2.46	362
September 5	W. F. Martin	21	46	1.70	250

Daily gage height, in feet, of Modesto canal at La Grange, Cal., for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1			2.4	0.2	2.6	2.5	2.25	0.85
2			2.5	.85	2.6	2.45	1.95	.85
3			2.6	1.1	2.6	2.45	1.8	.85
4			2.5	1.5	2.6	2.45	1.6	.85
5			2.65	1.9	2.55	2.45	1.65	.85
6			2.8	2.2	2.6	2.5	1.6	.85
7			2.8	2.6	2.55	2.5	1.55	.85
8			2.8	2.7	2.6	2.5	1.55	.8
9		1.4	2.8	2.85	2.55	2.45	1.5	.9
10		2.0	2.8	2.75	2.55	1.85	1.35	.95
11		2.0	2.8	2.5	2.6		1.45	.85
12		1.95	2.8	2.5	2.6		1.45	.85
13	1.5	2.25	2.8	2.5	2.6		1.4	.9
14	.65	2.3	2.8	1.65	2.6		1.25	1.1
15	1.15	2.3	2.8	2.6	2.6		1.35	1.05
16	1.5	2.35	2.8	2.55	2.6		1.35	1.0
17	1.7	2.3	2.8	2.5	2.6		1.3	1.0
18	1.8	2.3	2.8	2.5	2.5		1.2	.95
19	2.0	2.3	2.8	2.6	2.5		1.15	.95
20		2.4	2.8	2.6	2.45		1.05	.95
21		2.5	2.8	2.6	2.5		1.05	
22			2.8	2.6	2.5		1.0	
23			1.5	2.6	2.5	0.6	.95	
24				2.6	2.5	.5	.95	
25				2.6	2.5	1.3	.95	
26				2.55	2.45	1.9	1.0	
27				2.55	2.5	2.1	1.0	
28				2.6	2.5	2.2	.95	
29		2.45		2.6	2.5	1.95	.9	
30		2.5		2.65	2.5	1.95	.85	
31					2.5	1.9		

NOTE.—No gage height record was kept April 22 to 28. Discharges have been interpolated. The canal was dry on other days on which the gage was not read.

Rating table for Modesto canal at La Grange, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	90	1.10	156	1.70	238	2.30	328	2.90	428
0.60	100	1.20	169	1.80	253	2.40	344	3.00	445
0.70	110	1.30	182	1.90	268	2.50	360		
0.80	120	1.40	196	2.00	283	2.60	377		
0.90	131	1.50	210	2.10	298	2.70	394		
1.00	143	1.60	224	2.20	313	2.80	411		

NOTE.—This table is based on 11 discharge measurements made during 1906, and is well defined between gage heights 1.7 feet and 2.8 feet. Discharges have been included with those of Tuolumne River, page —. The total discharge of the canal for 1906 was 105,000 acre-feet.

TURLOCK CANAL AT LA GRANGE, CAL.

The Turlock canal, the property of the Turlock irrigation district, takes water from the left bank of Tuolumne River at the La Grange dam. This canal was designed to carry 1,500 second-feet and to irrigate a large area of fertile land in the vicinity of Turlock and Ceres, Stanislaus County, Cal.

During 1898 water was first turned into the canal in small quantities and used for puddling the banks. A record of the gage height has been kept since July, 1899. The conditions at this station are described in Water-Supply Paper No. 177, page 214, where are given also references to publications that contain data for previous years.

Discharge measurements of Turlock canal at La Grange, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 16	C. H. Lee	20	110	5.55	573
May 24	W. C. Sawyer	20	113	5.75	601
May 29	do	20	26	1.30	46
May 29	do	20	40	2.05	109
May 29	do	20	58	2.97	214
May 29	do	20	58	2.97	218
May 29	do	20	74	3.75	295
May 29	do	20	92	4.70	430
May 30	do	20	105	5.35	523
May 30	do	20	118	6.02	627
June 7	do	20	108	5.50	551
July 2	do	20	115	6.02	624
July 19	do	20	98	5.02	469
July 21	do	20	21	1.08	30
August 6	Sawyer and Martin	20	120	6.10	660
August 20	W. F. Martin	20	120	6.10	696
September 5	do	20	87	4.46	423

Daily gage height, in feet, of Turlock canal at La Grange, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1		5.25	3.25	....	4.5	5.0	6.05	6.05	5.05	2.5
2		5.6	3.25	2.0	4.1	5.0	6.05	6.05	5.25	2.4
3		5.6	2.9	2.0	4.4	5.0	6.05	6.05	4.1	2.4
4		5.6	2.4	2.0	5.4	5.0	6.0	6.05	4.35	2.4
5		5.7	2.0	2.0	5.35	5.6	6.05	6.05	4.4	2.4
6		5.7	2.0	2.0	5.35	5.5	6.05	6.0	4.3	2.4
7		5.7	2.0	2.0	5.35	5.5	6.05	6.05	4.25	2.35
8	2.05	5.7	2.0	2.0	5.35	5.65	6.05	6.05	4.2	2.3
9	2.05	5.75	....	2.0	5.35	5.75	6.05	6.05	4.05	....
10	2.65	4.65	....	....	5.6	5.75	6.05	6.05	3.75	....

Daily gage height, in feet, of Turlock canal at La Grange, Cal., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
11	2.65	5.7	....	....	5.6	5.8	6.05	6.05	3.9	....
12	2.7	5.9	....	2.5	5.6	5.8	6.05	6.05	3.9	....
13	2.7	5.1	....	2.6	5.6	5.8	6.05	6.05	3.8	....
14	2.6	4.55	....	2.5	5.6	5.8	6.05	6.05	3.4	....
15	2.5	5.1	....	2.5	5.6	5.5	6.05	6.05	3.5	....
16	2.55	5.4	....	2.5	5.6	6.0	0.05	6.05	3.4	....
17	2.6	2.25	....	2.5	5.6	6.0	6.05	6.05	3.4	....
18	2.1	....	....	2.5	5.6	6.0	6.05	6.65	3.0	....
19	2.5	3.0	....	2.5	5.6	6.0	5.08	6.0	3.05	....
20	2.7	3.7	....	2.5	5.6	6.0	6.05	6.05	2.85	....
21	2.7	3.75	0.75	2.6	5.7	6.0	6.05	6.05	2.85	....
22	2.7	4.6	2.0	2.6	5.8	6.0	6.05	0.0	2.75	....
23	2.8	4.0	1.25	2.6	5.8	6.0	6.05	0.0	2.75	....
24	2.4	3.2	....	2.6	5.85	6.0	6.05	5.02	2.7	....
25	0.5	3.5	....	2.6	5.05	6.05	6.05	5.02	2.7	....
26	1.7	3.5	....	3.15	5.9	6.0	6.05	5.45	2.75	....
27	3.7	3.5	....	3.6	4.7	6.05	6.05	5.87	2.75	....
28	3.9	3.5	....	3.6	5.7	6.05	6.05	5.04	2.7	....
29	3.9	....	....	3.6	5.45	6.05	6.05	5.05	2.6	....
30	5.1	....	....	4.0	5.6	6.05	6.05	5.15	2.55	....
31	5.1	....	....	....	5.3	....	6.05	5.00	....	....

NOTE.—The canal was dry on days when the gage was not read.

Rating table for Turlock canal at La Grange, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	4	1.50	58	2.50	156	3.50	274	5.00	478
0.60	6	1.60	67	2.60	167	3.60	287	5.20	508
0.70	10	1.70	76	2.70	178	3.70	300	5.40	538
0.80	14	1.80	85	2.80	189	3.80	313	5.60	568
0.90	19	1.90	94	2.90	201	3.90	326	5.80	598
1.00	25	2.00	104	3.00	213	4.00	339	6.00	628
1.10	31	2.10	114	3.10	225	4.20	365		
1.20	37	2.20	124	3.20	237	4.40	392		
1.30	44	2.30	134	3.30	249	4.60	420		
1.40	51	2.40	145	3.40	261	4.80	448		

NOTE.—This table is based on 17 discharge measurements made during 1906 and is well defined above gage heights 1 foot. Discharges have been included with those for Tuolumne River, p —. The total discharge of the canal for 1906 was 202,000 acre-feet

STANISLAUS RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Stanislaus River drains a portion of the western slope of the Sierra Nevada and heads well back on the crest, at elevations of from 10,000 to 12,000 feet. It drains the country between the basins of Mokelumne River on the north and Tuolumne River on the south, and flows in a general southwesterly direction, entering San Joaquin River 23 miles above Stockton. In the upper reaches of the basin it has many tributaries, which have their source in numerous small glacial lakes. The topography is rough and broken, with high mountain peaks. The formation is of granite, which is bare and destitute of timber growth above an elevation of 8,000 feet, except where small glacial lakes and moraines occur. In the middle reaches of the basin there is good soil covering and a heavy growth of timber. In this basin is situated the Calaveras grove of big trees (*Sequoia gigantea*), for which the Sierra Nevada is famous. This is the most northerly of the groves of these trees which extend as far south as the Kern River basin. The mean annual rainfall for the basin is about 50 inches. The precipitation falls chiefly in the form of snow on the higher elevations, remaining well into the summer months. Mining operations have been carried on extensively in this basin, and many canals have been taken out of the river, all of which discharge into the river again. The canal of the Stanislaus Water Company diverts water 3 miles above Knights Ferry and is used to irrigate land between Knights Ferry and Stockton. A gaging station is maintained on this canal to determine its discharge.

STANISLAUS RIVER AT KNIGHTS FERRY, CAL.

A station was first established on this river on May 3, 1895, at the railroad bridge one-half mile north of Oakdale. On July 30, 1898, a cable was placed 1,000 feet below the railroad bridge. This station was used until February 16, 1901.

The station at Knights Ferry was established May 19, 1903. It is located 200 feet from the post-office at Knights Ferry. The conditions at this station and the bench marks are described in Water Supply Paper No. 177, page 217, where are given also references to publications that contain data for previous years.

Discharge measurements of Stanislaus River at Knights Ferry, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 19	C. H. Lee	194	793	9.20	2,740
March 29	R. S. Hawley	221	989	10.37	3,920
April 24	do	230	1,030	10.60	4,370
April 25	Hawley and Ostrom	225	1,040	10.43	4,560
April 30	G. A. Ostrom	213	980	10.00	4,310
May 3	do	268	1,280	11.52	7,090
May 5	do	297	1,630	12.82	9,090
May 7	do	323	1,870	13.35	11,800
May 10	do	329	1,900	13.56	12,900
May 13	do	295	1,600	12.58	10,100
May 15	Ostrom and Lee	295	1,670	12.60	10,100
May 22	G. A. Ostrom	274	1,380	11.72	7,550
May 26	W. C. Sawyer	297	1,560	12.30	9,650
June 2	G. A. Ostrom	245	1,240	11.23	6,780
June 5	do	304	1,780	12.84	10,900
June 11	do	345	2,200	13.95	12,700
June 12	do	347	2,420	14.55	15,100
June 15	do	348	2,570	14.71	17,000
June [illegible]	W. C. Sawyer	328	1,640	12.55	10,200
June 21	G. A. Ostrom	291	1,860	13.40	12,300
June [illegible]	W. C. Sawyer	287	1,490	12.08	8,770
June [illegible]	G. A. Ostrom	242	1,260	10.98	6,640
July 10	W. C. Sawyer	241	1,180	10.78	5,800
July [illegible]	G. A. Ostrom	245	1,290	11.22	6,890
July 17	do	212	1,020	10.00	4,760
July [illegible]	do	194	849	9.30	3,360
July [illegible]	do	198	890	9.68	3,750
July 28	do	185	762	8.70	2,500
July 30	do	169	594	8.04	1,600
August [illegible]	do	160	521	7.63	1,330
August 9	do	153	403	7.16	1,020
August 16	do	140	388	6.68	634
August 27	do	131	327	6.34	405
September 5	W. F. Martin	128	299	6.13	273
September 9	G. A. Ostrom	128	294	6.08	239
September 18	do	121	254	5.86	170
September 28	do	118	238	5.75	115
October 9	do	114	227	5.64	71
October 19	do	113	221	5.58	71
November 23	W. F. Martin	125	256	5.82	129

Daily gage height, in feet, of Stanislaus River at Knights Ferry, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.4	7.15	8.6	11.5	10.25	10.8	12.0	7.8	6.3	5.8	5.7	5.8
2	6.3	7.2	8.4	19.8	19.8	11.1	12.2	7.75	6.25	5.8	5.7	5.8
3	6.3	7.25	8.45	19.3	11.4	11.4	12.4	7.65	6.25	5.8	5.7	5.7
4	6.3	7.3	9.3	9.95	11.8	12.3	12.3	7.55	6.15	5.8	5.85	5.8
5	6.25	7.25	8.8	9.75	12.35	12.5	12.15	7.45	6.15	5.8	6.45	5.8
6	6.3	7.35	8.65	9.7	12.95	11.4	11.75	7.4	6.1	5.8	6.15	5.8
7	6.3	7.35	8.6	9.7	12.7	11.05	11.6	7.4	6.1	5.85	5.9	5.8
8	6.25	7.3	8.55	9.8	12.85	11.3	11.6	7.35	6.1	5.75	5.9	6.2
9	6.3	7.35	8.65	11.0	12.85	12.05	11.2	7.3	6.1	5.75	5.85	5.9
10	6.3	7.4	8.7	10.4	12.9	12.85	19.6	7.25	6.15	5.75	5.85	6.05
11	6.3	7.5	8.8	10.3	13.35	13.5	10.5	7.2	6.15	5.8	5.85	13.1
12	7.9	7.35	11.1	9.9	12.15	14.1	10.65	7.1	6.1	5.75	5.85	9.95
13	11.35	7.35	10.5	10.9	11.65	13.85	11.1	7.0	6.0	5.75	5.9	7.65
14	19.45	7.5	10.15	10.2	11.8	12.8	10.8	7.0	6.9	5.75	5.7	6.85
15	9.1	8.8	13.2	19.3	12.3	12.8	19.4	6.8	6.0	5.75	5.6	6.55
16	8.8	8.3	10.6	10.6	11.3	13.4	19.9	6.75	6.0	5.9	5.6	6.55
17	9.9	8.0	9.9	10.55	11.2	13.15	9.95	6.7	6.9	5.7	5.6	6.3
18	13.25	7.95	9.35	19.75	11.8	12.4	9.55	6.65	5.95	5.7	5.7	6.2
19	14.1	8.95	9.05	10.8	12.1	13.0	9.3	6.7	5.9	5.7	5.65	6.2
20	9.9	8.7	9.9	11.15	12.1	12.9	9.3	6.8	5.85	5.7	5.6	6.15
21	8.9	9.9	9.2	11.4	11.9	12.9	9.25	6.7	5.8	5.7	5.7	6.1
22	8.4	9.85	9.75	11.6	11.5	12.8	9.3	6.6	5.8	5.75	5.7	6.1
23	8.05	9.3	10.2	11.85	11.0	12.45	9.5	6.55	5.8	5.7	5.7	6.25
24	7.9	9.25	14.1	19.9	19.9	12.15	9.45	6.45	5.8	5.75	5.75	6.35
25	7.75	9.4	14.3	10.4	19.8	12.55	9.4	6.35	5.85	5.75	5.8	7.65
26	7.65	8.95	13.0	10.2	11.9	12.1	9.2	6.3	5.9	5.75	5.8	9.3
27	7.55	8.8	11.5	19.3	11.7	11.1	9.9	6.25	5.9	5.75	5.8	9.35
28	7.5	9.9	10.75	19.5	12.05	10.7	8.7	6.25	5.8	5.7	5.8	8.45
29	7.5	....	10.4	10.1	11.1	19.8	8.4	6.2	5.8	5.7	5.8	7.75
30	7.45	....	11.1	10.9	19.75	11.2	8.15	6.2	5.75	5.7	5.8	7.45
31	7.3	....	13.55	....	10.6	....	7.95	6.3	....	5.7	....	8.3

Rating table for Stanislaus River at Knights Ferry, Cal., for 1906.

Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.60	65	6.70	640	7.80	1,549	8.90	2,800	11.00	6,140
5.70	95	6.80	710	7.90	1,640	9.00	2,930	11.20	6,540
5.80	130	6.90	790	8.00	1,740	9.20	3,200	11.40	6,970
5.90	170	7.00	870	8.10	1,850	9.40	3,480	11.60	7,410
6.00	220	7.19	950	8.20	1,960	9.60	3,760	11.80	7,880
6.19	270	7.20	1,030	8.30	2,070	9.80	4,060	12.00	8,390
6.20	320	7.30	1,110	8.40	2,190	10.00	4,380	13.00	11,110
6.30	380	7.40	1,190	8.50	2,310	19.20	4,719	14.00	14,020
6.40	440	7.50	1,270	8.60	2,430	10.40	5,050	15.00	17,180
6.50	500	7.60	1,360	8.70	2,550	10.60	5,400		
6.60	579	7.70	1,450	8.80	2,670	19.80	5,760		

NOTE.—This table is based on 40 discharge measurements made during 1906 and is well defined.

Monthly discharge of Stanislaus River at Knights Ferry, Cal., for 1906.

[Drainage area, 935 square miles.]

Month.	Discharge in second-feet			Total in acre-feet.	Run-off	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	14,400	386	2,470	152,000	2.64	3.04
February	4,290	1,060	2,070	115,000	2.21	2.30
March	14,900	2,200	5,330	328,000	5.70	6.57
April	8,110	3,920	5,330	317,000	5.70	6.36
May	12,200	4,920	8,090	497,000	8.65	9.97
June	14,400	5,590	9,340	556,000	9.99	11.15
July	9,600	1,790	5,210	320,009	5.57	6.42
August	1,600	415	910	56,000	.973	1.12
September	490	207	309	18,400	.330	.37
October	251	162	193	11,900	.206	.24
November	551	87	181	19,800	.194	.22
December	11,400	141	1,270	78,100	1.36	1.57
The year	14,900	87	3,390	2,460,000	3.63	49.33

NOTE.—The discharge of Stanislaus Water Company's canal and Schell ditch is included above. The discharge of Schell ditch has been assumed as 7 second-feet. Values are excellent, except January to April, which are rated as fair, because measurements made during that period give a discharge somewhat less than the rating.

STANISLAUS WATER COMPANY'S CANAL AT KNIGHTS FERRY, CAL.

This station was established June 11, 1904. It is located below the point where Schell ditch diverts its water, about 1 mile below the Stanislaus Milling and Power Company's power house and 200 feet below the place where it passes under the Schell-ditch flume. The water diverted by this ditch is used for irrigation in the vicinity of Oakdale, Cal.

Discharge measurements of Stanislaus Water Company's canal at Knights Ferry, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
May 15	C. H. Lee	9	25.0	3.35	103
May 26	W. C. Sawyer	9	26.3	3.48	108
June 15	do	9	26.6	3.60	119
July 10	do	9	29.0	3.77	132

Daily gage height, in feet, of Stanislaus Water Company's canal at Knights Ferry, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.9	......	1.65	3.5	3.6	3.75	2.55	3.4	3.1	2.95	2.25
2	1.9	2.65	......	1.5	3.5	3.7	3.8	3.3	3.15	3.0	2.95	2.35
3	2.15	2.7	......	2.0	3.5	3.8	3.7	3.25	3.25	3.1	2.95	2.4
4	2.25	2.75	......	2.45	3.3	3.7	3.85	2.8	3.2	3.05	3.0	2.0
5	2.25	2.75	......	2.15	3.4	3.7	3.8	2.95	3.2	3.0	3.0	1.5
6	2.4	2.8	......	......	3.4	3.85	3.75	3.4	3.1	2.95	2.9	1.65
7	2.4	2.75	......	......	3.2	3.6	3.8	3.45	3.2	3.0	2.85	1.85
8	2.15	2.8	3.1	......	3.5	3.8	3.8	3.45	3.1	2.9	2.7	2.1
9	2.3	3.1	3.35	3.1	3.7	3.8	3.8	3.4	3.2	3.0	2.9	2.2
10	2.25	3.05	3.55	2.1	3.6	3.9	3.5	3.4	3.05	3.0	2.95	2.5
11	2.2	3.0	3.2	2.05	3.3	3.8	3.8	3.4	3.0	3.05	2.95	1.9
12	2.35	2.5	3.0	2.65	3.5	3.6	2.7	3.3	2.95	3.0	2.5	2.05
13	2.45	2.2	2.85	2.7	3.6	3.65	3.75	3.2	2.95	3.0	2.5	2.0
14	2.65	2.6	2.7	2.8	3.5	3.7	3.8	3.1	2.9	3.15	2.22	1.75
15	2.6	3.0	2.45	3.0	3.55	3.7	3.2	3.15	3.1	3.05	1.9	1.6
16	2.6	3.05	2.45	3.3	3.35	3.75	2.85	3.3	3.1	3.0	2.12	1.3
17	2.75	3.1	2.2	3.4	3.6	3.55	3.2	3.3	2.85	3.05	2.05	1.9
18	2.1	3.15	2.2	3.5	3.3	3.6	2.95	3.1	3.1	2.9	1.4	1.65
19	2.5	2.75	2.6	3.55	3.6	3.6	3.5	3.2	3.1	2.95	1.45	1.4
20	2.2	2.8	3.0	3.6	3.65	3.6	3.0	3.5	3.15	2.8	1.7	1.8
21	2.15	2.9	2.8	3.55	3.65	3.6	3.55	3.5	3.2	2.8	1.1	2.35
22	1.5	2.8	3.0	3.65	3.75	3.55	2.8	3.4	3.2	2.85	1.15	2.4
23	1.35	2.75	3.0	3.35	3.75	3.6	3.6	3.4	3.15	2.9	1.15	2.45
24	......	2.8	2.1	......	3.75	3.25	3.7	3.4	3.1	2.9	1.65	2.3
25	......	2.45	......	3.6	3.7	3.6	3.7	3.15	3.05	2.9	1.65	1.95
26	......	......	......	3.7	3.6	3.7	3.7	3.4	3.0	2.95	2.25	1.9
27	......	......	......	3.6	3.6	......	3.7	3.3	3.15	2.9	2.3	2.25
28	......	......	......	3.5	3.1	......	3.2	3.25	3.2	2.9	2.3	2.1
29	......		......	3.3	3.3	3.0	3.65	3.2	3.05	2.85	2.35	2.1
30	......		......	3.3	3.5	3.25	3.45	3.2	3.2	2.95	2.15	2.3
31	2.65		......		3.5		3.3	3.4	......	3.0	......	2.3

NOTE.—Canal was dry on days when gage was not read.

Rating table for Stanislaus Water Company's canal at Knights Ferry for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	0	1.40	9	2.10	27	2.80	60	3.50	111
0.80	0.7	1.50	11	2.20	31	2.90	67	3.60	119
0.90	1.5	1.60	13	2.30	35	3.00	74	3.70	127
1.00	2.5	1.70	15	2.40	39	3.10	81	3.80	135
1.10	4.0	1.80	17	2.50	44	3.20	88	3.90	143
1.20	5.5	1.90	20	2.60	49	3.30	95	4.00	151
1.30	7	2.00	23	2.70	54	3.40	103		

NOTE.—This table is based on 13 discharge measurements made during 1905-6 and is well defined. Discharges have been included in those for Stanislaus River, p. 170. The total discharge of the canal in 1906 was 50,300 acre-feet.

MOKELUMNE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Mokelumne River drains an area of 657 square miles of the western slope of the Sierra Nevada. It has numerous tributaries, North, South, and Middle forks being the most important. This stream heads well back in the main crest of the Sierra Nevada at an elevation of 8,000 feet.

The formation is of granite, with good soil covering and heavy timber growth on the middle and higher elevations. On the lower elevations the slopes are less rugged and the soil covering is of brush and scattering oak timber, with large areas of cultivated land and pasture. There are numerous small glacial lakes and moraines in the upper reaches of this basin. The precipitation varies from 25 inches on the lower to 50 inches on the higher elevations, where it falls in the form of snow, which melts in the early spring. The greatest discharge usually occurs in April, May, and June. There is some artificial storage in this basin, but not enough to have much effect on the discharge.

Several diversions are made for mining and power purposes within the drainage basin, and this water is returned to the river above the gaging station, which is located at Clements, a few miles above Lodi, Cal.

MOKELUMNE RIVER NEAR CLEMENTS, CAL.

This station was established October 28, 1904. It is located at the highway bridge, 1 mile north of Clements. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 223, where are given also references to publications that contain data for previous years.

Discharge measurements of Mokelumne River near Clements, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 11	F. R. S. Buttemer	122	212	4.60	492
February 27	...do	248	584	6.50	1,460
March 12	...do	251	1,310	9.15	3,790
March 19	...do	247	616	6.48	1,500
April 14	W. C. Sawyer	255	962	8.28	2,630
April 20	...do	248	1,260	9.40	3,780
April 21	...do	250	1,400	10.00	4,340
April 28	...do	248	1,000	8.40	2,750
May 9	...do	251	1,710	11.55	5,730
May 10	...do	249	1,870	12.18	6,450
May 22	...do	252	1,220	10.02	3,720
May 23	...do	248	1,090	9.50	3,170
June 12	...do	263	2,470	14.35	8,610
June 13	...do	263	2,460	14.29	8,730
June 19	...do	251	1,970	12.20	6,440
June 20	...do	256	2,330	13.68	7,680
June 27	...do	249	1,390	9.80	3,780
June 28	...do	249	1,320	9.60	3,480
July 7	...do	250	1,610	10.75	4,740
July 17	...do	248	1,080	8.69	2,760
July 18	...do	258	1,060	8.46	2,720
July 28	...do	236	602	6.52	1,340
July 30	...do	204	392	5.65	826
August 7	Sawyer and Martin	131	188	4.52	400
September 3	W. F. Martin	77	141	4.05	221
November 24	...do	57	113	3.77	163
November 27	R. S. Hawley	55	107	3.75	161

Daily gage height, in feet, of Mokelumne River near Clements, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.05	4.5	6.05	11.2	8.45	9.45	10.95	5.15	3.8	3.8	4.0	3.9
2	3.1	4.4	5.6	9.95	9.05	9.9	12.25	5.0	3.9	3.9	3.95	4.1
3	3.1	4.45	5.85	8.75	10.5	10.45	12.15	5.2	3.8	3.85	3.95	3.75
4	3.15	4.4	6.45	8.3	10.85	12.2	13.2	5.1	3.75	3.75	4.1	3.95
5	3.15	4.45	5.75	7.95	11.6	12.15	12.4	4.95	3.75	3.95	5.15	4.0
6	3.15	4.5	5.7	7.9	12.45	10.45	12.2	4.7	3.85	4.0	4.5	4.0
7	3.15	4.5	5.75	7.75	12.5	9.6	11.35	5.15	4.0	3.85	4.4	3.95
8	3.1	4.45	5.75	7.6	12.1	10.05	11.45	4.6	3.9	3.7	4.15	4.0
9	3.1	4.5	5.95	7.75	12.4	11.6	11.15	4.8	4.05	4.0	4.1	4.2
10	3.1	4.65	6.05	8.3	12.1	13.8	10.7	4.6	4.2	3.95	4.1	3.95
11	3.15	4.7	6.05	8.5	12.2	14.3	10.4	4.9	4.4	3.85	3.75	10.8
12	3.3	4.55	8.4	8.0	11.15	14.4	10.05	5.0	......	3.95	3.8	8.35
13	5.6	4.5	8.1	7.8	10.2	13.8	10.05	4.55	3.9	3.9	3.8	5.75
14	7.95	4.6	7.5	7.9	10.4	12.2	10.1	4.4	3.95	3.85	3.9	4.95
15	6.05	5.05	11.5	8.3	10.9	11.7	9.65	4.4	4.0	3.9	4.1	4.7
16	6.6	5.75	8.15	8.6	9.55	13.3	9.4	4.15	3.95	3.95	4.2	4.7
17	7.75	5.15	7.4	8.6	9.15	12.9	8.9	3.9	4.05	3.95	4.0	4.4
18	11.45	5.45	6.8	8.75	10.15	11.95	8.2	3.9	3.85	3.95	4.2	4.35
19	12.7	6.75	6.45	8.95	10.75	12.55	7.55	3.9	3.85	3.9	4.2	4.25
20	7.9	6.2	6.25	9.45	10.9	12.6	7.9	3.95	3.9	3.9	4.2	4.3
21	7.0	7.45	6.65	9.9	10.45	12.45	7.85	3.85	3.9	3.75	4.2	4.3
22	5.7	7.3	7.2	10.3	10.35	12.7	7.0	3.85	3.9	3.75	4.2	4.3
23	5.3	6.5	8.1	10.3	9.4	12.2	7.5	3.95	3.9	3.95	4.2	4.9
24	5.15	6.2	11.55	9.15	9.15	11.75	7.0	3.95	3.85	3.9	3.85	4.1
25	4.9	6.1	12.05	8.55	9.15	12.25	6.65	4.2	3.95	3.95	3.85	6.7
26	4.85	6.0	11.85	8.1	10.5	11.55	6.45	4.0	3.9	4.0	3.6	8.55
27	4.7	6.25	10.45	8.25	10.5	10.9	6.25	3.8	4.0	3.85	3.95	8.5
28	4.6	6.45	9.15	8.5	10.75	10.1	6.25	3.85	4.0	4.05	3.95	7.1
29	4.55	......	8.5	8.05	10.2	10.45	5.65	3.8	3.9	3.8	4.1	6.3
30	4.5	......	8.7	8.0	9.35	10.5	5.45	3.95	3.85	3.95	3.9	4.8
31	4.45	......	13.45	......	9.25	......	5.3	3.85	......	4.05	......	6.8

Rating table for Moketumne River near Clements, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	50	4.10	250	5.20	680	6.60	1,450	8.80	3,010
3.10	60	4.20	280	5.30	730	6.80	1,570	9.00	3,180
3.20	70	4.30	315	5.40	780	7.00	1,690	10.00	4,125
3.30	80	4.40	350	5.50	830	7.20	1,830	11.00	5,175
3.40	90	4.50	390	5.60	880	7.40	1,970	12.00	6,225
3.50	105	4.60	430	5.70	930	7.60	2,110	13.00	7,275
3.60	120	4.70	470	5.80	980	7.80	2,250	14.00	8,325
3.70	140	4.80	510	5.90	1,030	8.00	2,390		
3.80	160	4.90	550	6.00	1,090	8.20	2,530		
3.90	190	5.00	590	6.20	1,210	8.40	2,690		
4.00	220	5.10	630	6.40	1,330	8.60	2,850		

NOTE.—This table is based on 27 discharge measurements made during 1906, and is well defined between gage heights 3.7 feet and 14.3 feet.

Monthly discharge of Mokelumne River near Clements, Cal., for 1906.

[Drainage area, 642 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	6,960	55	996	61,200	1.55	1.79
February	2,000	350	808	44,900	1.26	1.31
March	7,750	880	2,520	155,000	3.92	4.52
April	5,380	2,110	2,940	175,000	4.57	5.10
May	6,750	2,730	4,700	289,000	7.32	8.44
June	8,740	3,580	6,020	358,000	9.38	10.46
July	7,480	730	3,540	218,000	5.51	6.35
August	680	160	356	21,900	.554	.64
September	350	150	202	12,000	.315	.35
October	235	140	190	11,700	.296	.34
November	655	120	248	14,800	.386	.43
December	4,960	150	876	53,900	1.36	1.57
The year	8,740	55	1,950	1,420,000	3.04	41.30

NOTE.—These values are excellent, except January to March, which are rated as good because the measurements made during that period give a discharge somewhat in excess of the rating.

NORTHERN PACIFIC OCEAN DRAINAGE.

KLAMATH RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Klamath River drains a large area in California and Oregon, lying between the basins of Sacramento River on the south, Deschutes and Rogue rivers on the north, and the minor streams of the Great Basin on the east. Its headwaters lie at elevations of from 7,000 to 9,000 feet. The region contains many flat valleys in which the soil is favorable to irrigation. Many of the streams flow through marshes, which are susceptible of drainage and cultivation. The water surface in the basin is large, comprising three large lakes and many smaller ones.

Link River rises in Upper Klamath Lake and flows through a large swamp area, feeding Lower Klamath Lake by overflow at high water and receiving water from the lake at low stages. Below Keno it is known as Klamath River, and flows southwestward through Siskiyou, Humboldt. and Del Norte counties, in California emptying into the Pacific.

Important power possibilities exist on the stream, notably at Klamath Falls and at the rapids below Keno. Upper Klamath Lake is fed by Williamson River, and several smaller streams. Sycan River flows into Sprague River, a tributary of Williamson River.

Tule Lake lies just east of Lower Klamath Lake and has no surface outlet, but may have underground ones. Evaporation records at Keno indicate an annual loss of about 38 inches, while the rainfall and inflow amount to about 60 inches over the lake surface. The formation of the country is of a volcanic nature, showing many fissures where the rock is exposed, and this, together with the fact that many springs exist in the country to the southwest, tend to confirm the existence of such passages.

Lost River rises in Clear Lake and forms the principal supply of Tule Lake. Miller Creek enters Lost River from the east.

LINK RIVER AT KLAMATH FALLS, OREG.[a]

This station was established May 15, 1904. It is located at the county bridge at Klamath Falls, Oreg., 1½ miles below the outlet of Klamath Lake. The conditions at this station and the bench marks are described in Water Supply Paper No. 177, page 226, where are given also references to publications that contain data for previous years.

Discharge measurements of Link River at Klamath Falls, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11	L. F. Hendricks	298	1,900	5.06	4,560
June 20	do	290	1,650	4.65	3,400
June 22	Clapp and Hendricks	290	1,650	4.65	3,640
July 9	L. F. Hendricks	285	1,530	4.25	2,860
July 24	do	280	1,420	3.80	2,190
August 22	do	269	1,190	3.00	1,390
December 20	do	279	1,310	3.48	2,050

Daily gage height, in feet, of Link River at Klamath Falls, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.65	3.75	4.25	5.0	4.85	4.4	3.5	2.9	2.85	3.0	3.3
2	3.45	3.65	3.9	4.2	5.05	4.85	4.35	3.5	2.85	2.9	3.3	3.25
3	3.4	3.65	3.85	4.2	5.0	4.9	4.4	3.5	2.9	2.8	3.4	3.25
4	3.5	3.65	3.7	4.2	4.95	4.9	4.4	3.45	2.9	2.8	[b]2.95	3.3
5	3.5	3.65	3.7	4.2	5.0	4.95	4.3	3.45	2.9	2.85	2.95	3.3
6	3.45	3.6	3.7	4.3	5.0	4.8	4.3	3.4	2.85	[b]2.85	2.95	3.3
7	3.45	3.6	3.7	4.35	4.95	4.8	4.25	3.35	2.95	[b]2.85	2.95	3.45
8	3.45	3.6	3.7	4.45	4.95	4.85	4.3	3.3	2.95	2.85	3.0	3.3
9	3.5	3.6	3.75	4.4	5.0	4.8	4.25	3.3	[b]2.9	2.85	3.05	[b]3.3
10	3.5	3.6	3.75	4.5	5.05	4.95	4.2	3.3	2.8	2.85	3.05	3.45

[a] This station was known as Klamath River at Klamath Falls, Oreg., in report for 1904.

[b] Estimated.

Daily gage height, in feet, of Link River at Klamath Falls, Oreg., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	3.5	3.6	3.7	4.5	5.05	5.0	4.15	3.3	2.8	2.85	3.05	3.4
12	3.5	3.6	3.85	4.5	4.9	4.9	4.15	3.2	2.85	2.8	3.1	3.4
13	3.5	3.6	3.9	4.55	4.9	4.75	4.15	3.15	2.8	2.8	3.15	3.4
14	3.6	3.6	3.9	4.6	5.1	4.7	4.05	3.2	2.8	2.9	3.1	3.4
15	3.55	3.65	3.95	4.65	5.0	4.8	4.05	3.15	2.8	2.85	3.2	3.5
16	3.8	3.6	3.9	4.75	4.9	4.75	4.05	3.15	2.85	2.85	3.2	3.45
17	3.8	3.65	3.9	4.8	4.9	4.7	4.05	3.15	2.85	2.85	3.25	3.5
18	3.8	3.75	3.95	4.8	5.15	4.65	4.00	3.1	2.85	2.85	3.2	3.45
19	3.85	3.65	3.9	4.8	4.95	4.6	3.95	3.1	2.85	2.85	3.2	3.4
20	3.8	3.65	3.95	4.85	4.9	4.65	3.95	3.05	2.85	2.9	3.2	3.5
21	3.85	3.7	4.0	4.9	4.85	4.55	3.95	3.1	2.85	2.9	3.25	3.5
22	3.7	3.7	3.95	4.95	4.8	4.6	3.85	3.0	2.8	2.9	3.15	3.6
23	3.75	3.75	4.15	5.0	4.85	4.6	3.8	2.95	2.8	2.9	3.25	[a]3.5
24	3.75	3.7	3.95	4.95	4.9	4.6	3.75	3.0	2.9	2.9	3.3	3.5
25	3.7	3.7	4.05	4.95	5.1	4.55	3.75	3.0	2.9	2.9	[a]3.3	[a]3.5
26	3.7	3.85	4.0	4.95	5.0	4.55	3.7	3.05	2.85	2.9	3.3	3.6
27	3.7	3.7	4.0	5.05	4.95	4.5	3.65	3.0	2.85	2.95	3.3	3.6
28	3.7	3.6	4.05	5.1	5.0	4.5	3.7	2.9	2.85	2.95	3.3	3.6
29	3.7	......	4.1	5.0	4.9	4.45	3.6	3.0	2.85	2.95	3.3	3.6
30	3.7	......	4.2	4.95	4.9	4.45	3.55	2.9	2.85	2.9	3.3	3.6
31	3.65	......	4.2	......	4.9	......	3.55	2.9	......	3.0	......	3.6

[a] Estimated.

Rating table for Link River at Klamath Falls, Oreg., for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.80	1,150	3.30	1,585	3.80	2,175	4.30	2,900	4.80	3,770
2.90	1,220	3.40	1,690	3.90	2,310	4.40	3,000	4.90	3,960
3.00	1,300	3.50	1,800	4.00	2,450	4.50	3,250	5.00	4,150
3.10	1,390	3.60	1,920	4.10	2,590	4.60	3,400	5.10	4,340
3.20	1,485	3.70	2,045	4.20	2,740	4.70	3,580	5.20	4,550

NOTE.—This table is based on discharge measurements made during 1904-1906 and is fairly well defined.

Monthly discharge of Link River at Klamath Falls, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	2,240	1,690	1,950	120,000
February	2,240	1,920	1,990	111,000
March	2,740	2,040	2,320	143,000
April	4,340	2,740	3,520	209,000
May	4,440	3,770	4,080	251,000
June	4,150	3,140	3,620	215,000
July	3,000	1,860	2,490	153,000
August	1,800	1,220	1,470	90,400
September	1,260	1,150	1,190	70,800
October	1,300	1,150	1,200	73,800
November	1,600	1,200	1,400	86,900
December	1,920	1,540	1,740	107,000
The year	4,440	1,150	2,250	1,630,000

NOTE.—These values are good.

UPPER KLAMATH LAKE NEAR KLAMATH FALLS, OREG.

This station was established in January, 1906, for recording the water level in Upper Klamath Lake. It is located at the southeast end of the lake and above the upper riffle at the head of Link River.

The gage is a vertical timber, graduated to feet and tenths and fastened to posts driven in the lake bed a short distance from the shore of the lake.

On February 16, 1906, a Friez's automatic water-stage register was installed and the mean daily gage height record has been computed from its register sheets.

Daily gage height, in feet, of Upper Klamath Lake at Klamath Falls, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.			5.30		7.00	6.30	5.70	4.95	4.50	4.50	4.70	5.00
2.			5.25		6.80	6.20	5.75	4.90	4.55	4.65	4.30	4.90
3.			5.35		6.80	6.10	5.70	4.90	4.50	4.65	4.50	4.90
4.		5.21	5.35		6.80	6.20	5.75	4.85	4.50	4.60	4.50	4.90
5.			5.40		6.70	6.30	5.70	4.90	4.50	4.55	4.60	4.90
6.			5.40		6.60	6.20	5.65	4.90	4.50	4.50	4.60	4.90
7.	5.02		5.40	6.15	6.50	6.20	5.60	4.90	4.35	4.50	4.70	4.90
8.			5.40	6.10	6.50	6.10	5.65	4.90	4.50	4.50	4.80	4.90
9.			5.40	6.20	6.40	6.20	5.60	4.80	4.60	4.50	4.80	4.95
10.			5.51	6.40	6.30	5.90	5.55	4.75	4.65	4.50	4.80	4.80
11.		5.02		6.40	6.60	5.70	5.50	4.70	4.55	4.50	4.85	5.00
12.				6.30	6.60	6.20	5.40	4.80	4.40	4.55	4.75	5.00
13.				6.40	6.40	6.20	5.45	4.70	4.60	4.50	4.90	5.00
14.	5.10			6.50	6.20	6.10	5.40	4.75	4.65	4.55	4.85	5.00
15.				6.30	6.40	6.00	5.45	4.70	4.50	4.45	4.80	5.00
16.		5.20		6.50	6.40	6.20	5.35	4.75	4.55	4.50	5.00	4.95
17.		5.20	5.50	6.50	6.30	6.10	5.35	4.70	4.50	4.65	5.30	5.00
18.		5.21	5.50	6.50	6.30	6.20	5.30	4.75	4.55	4.70	5.15	4.95
19.		5.21	5.50	6.50	6.40	6.20	5.25	4.70	4.55	4.80	5.95	5.00
20.		5.20	5.40	6.30	6.50	6.20	5.20	4.70	4.55	4.75	5.85	5.05
21.	4.38	5.22	5.20	6.50	6.40	6.10	5.30	4.70	4.50	4.65	5.00	5.05
22.		5.23	5.20	6.60	6.30	6.10	5.20	4.60	4.35	4.60	5.15	5.00
23.		5.25	5.00	6.80	6.30	6.10	5.20	4.55	4.50	4.55	5.20	5.05
24.		5.26	5.52	6.70	6.10	6.00	5.15	4.50	4.55	4.55	5.05	5.10
25.		5.35	5.45	6.80	5.90	6.00	5.20	4.45	4.55	4.60	5.15	5.05
26.		5.35	5.50	6.70	6.20	6.05	5.15	4.55	4.55	4.55	5.15	5.10
27.		5.40	5.60	6.90	6.20	6.00	5.10	4.55	4.55	4.60	5.10	5.15
28	5.20	5.35	5.55	7.00	6.50	5.95	5.10	4.55	4.50	4.60	5.05	5.15
29.			5.55	7.00	6.50	5.90	5.00	4.50	4.50	4.65	5.00	5.05
30.			5.50	6.80	6.40	5.80	5.10	4.50	4.55	4.70	5.00	5.10
31.			6.45		6.40		5.00	4.50		4.75		5.15

KLAMATH RIVER AT KENO, OREG.

This station was established August 13, 1904. It is located one-fourth mile below the county bridge at Keno, Oreg. The conditions at this station and the bench marks are described in Water Supply Paper No. 177, page 229, where are given also references to publications that contain data for previous years.

Discharge measurements of Klamath River at Keno, Oreg, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 8	L. F. Hendricks	456	4.110	13.7	3,600
June 30	do	430	3,840	13.4	3,330
July 23	do	420	3,630	12.9	2,540
September 5	do	405	3,300	12.05	1,170

Daily gage height, in feet, of Klamath River at Keno, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.5	12.8	12.8	13.1	13.6	13.7	13.4	12.6	12.1	12.0	12.2	12.4
2	12.5	12.8	12.9	13.1	13.6	13.7	13.4	12.6	12.1	12.0	12.2	12.4
3	12.5	12.8	12.9	13.1	13.6	13.7	13.4	12.6	12.1	12.0	12.2	12.5
4	12.5	12.8	12.8	13.1	13.7	13.7	13.3	12.6	12.1	12.0	12.2	12.5
5	12.5	12.8	12.8	13.1	13.7	13.7	13.3	12.6	12.1	12.0	12.2	12.5
6	12.5	12.8	12.8	13.2	13.7	13.7	13.3	12.6	12.1	12.0	12.2	12.5
7	12.5	12.8	12.8	13.2	13.7	13.7	13.3	12.5	12.1	12.0	12.2	12.5
8	12.5	12.7	12.8	13.2	13.7	13.7	13.3	12.5	12.1	12.0	12.2	12.5
9	12.5	12.7	12.8	13.2	13.7	13.7	13.3	12.5	12.1	12.0	12.2	12.5
10	12.5	12.7	12.8	13.2	13.7	13.7	13.2	12.5	12.1	12.0	12.2	12.5
11	12.4	12.7	12.8	13.3	13.7	13.7	13.2	12.5	12.1	12.0	12.2	12.5
12	12.5	12.7	12.8	13.3	13.7	13.6	13.2	12.5	12.0	12.0	12.3	12.5
13	12.6	12.7	12.8	13.3	13.7	13.6	13.2	12.5	12.0	12.0	12.3	12.5
14	12.7	12.7	12.8	13.3	13.7	13.6	13.2	12.4	12.0	12.0	12.3	12.5
15	12.6	12.7	12.9	13.3	13.7	13.6	13.2	12.4	12.0	12.0	12.3	12.5
16	12.7	12.7	12.9	13.4	13.7	13.6	13.2	12.4	12.0	12.0	12.3	12.5
17	12.7	12.7	12.9	13.4	13.7	13.6	13.1	12.3	12.0	12.0	12.3	12.6
18	12.7	12.7	12.9	13.4	13.7	13.6	13.1	12.3	12.0	12.0	12.3	12.6
19	12.8	12.7	12.9	13.5	13.7	13.6	13.1	12.3	12.0	12.0	12.4	12.6
20	12.8	12.7	12.9	13.5	13.7	13.5	13.1	12.3	12.0	12.1	12.4	12.6
21	12.8	12.7	12.9	13.5	13.7	13.5	13.1	12.3	12.0	12.1	12.4	12.6
22	12.8	12.8	12.9	13.5	13.7	13.5	13.0	12.2	12.0	12.1	12.4	12.7
23	12.8	12.8	12.9	13.5	13.7	13.5	12.9	12.2	12.0	12.1	12.4	12.6
24	12.8	12.8	12.9	13.5	13.7	13.5	12.9	12.2	12.0	12.1	12.4	12.6
25	12.8	12.8	13.0	13.5	13.7	13.5	12.8	12.2	12.0	12.1	12.4	12.6
26	12.8	12.8	13.0	13.5	13.7	13.5	12.8	12.2	12.0	12.1	12.4	12.6
27	12.8	12.8	13.0	13.6	13.7	13.5	12.8	12.2	12.0	12.1	12.4	12.6
28	12.8	12.8	13.0	13.6	13.7	13.4	12.8	12.2	12.0	12.1	12.4	12.6
29	12.8	......	13.0	13.6	13.7	13.4	12.7	12.2	12.0	12.1	12.4	12.6
30	12.8	......	13.0	13.6	13.7	13.4	12.7	12.2	12.0	12.1	12.4	12.7
31	12.8	......	13.0	......	13.7	......	12.7	12.1	......	12.2	......	12.7

Rating table for Klamath River at Keno, Oreg., for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
12.00	1,240	12.40	1,700	12.80	2,250	13.20	2,910	13.60	3,730
12.10	1,350	12.50	1,830	12.90	2,400	13.30	3,100	13.70	3,960
12.20	1,460	12.60	1,960	13.00	2,560	13.40	3,300		
12.30	1,580	12.70	2,100	13.10	2,730	13.50	3,510		

Note.—This table is based on discharge measurements made during 1904-1906 and is well defined.

Monthly discharge of Klamath River at Keno, Oreg., for 1906.

Month.	Discharge in second-feet			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	2,250	1,700	2,050	126,000
February	2,250	2,100	2,180	121,000
March	2,560	2,250	2,380	146,000
April	3,730	2,730	3,220	192,000
May	3,960	3,730	3,940	242,000
June	3,960	3,300	3,710	221,000
July	3,300	2,100	2,750	169,000
August	1,960	1,350	1,680	103,000
September	1,350	1,240	1,280	76,200
October	1,460	1,240	1,290	79,300
November	1,700	1,460	1,580	94,000
December	2,100	1,700	1,900	117,000
The year	3,960	1,240	2,330	1,690,000

Note.—These values are excellent.

SYCAN RIVER NEAR SILVERLAKE, OREG.

This station was established May 2, 1905, and discontinued October 12, 1905. It is located about 30 miles south of Silverlake, Oreg., in sec. 19, T. 32 S., R. 14 E. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 232.

Discharge measurements of Sycan River near Silverlake, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 16	Ivan Landes	21	27.6	2.40	38
April 10	do	30	46.5	3.05	110
May 2	do	56	92.6	3.45	183
June 12	do	52	43.9	2.32	69
July 30	H. W. King	19	11.9	1.27	10.2
October 3	Ivan Landes	14	14.9	1.70	5.4
November 7	do	12	7.1	1.12	6.0
1906.					
May 9	Ivan Landes	62	238	6.20	559
May 31	do	59	167	4.80	344

Daily discharge, in second-feet, of Sycan River near Silverlake, Oreg., for 1905.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	160	87	33	10	6	8	17	177	57	17	1	10	12
2	163	87	33	10	6	5	18	164	50	17	2	12	17
3	150	87	30	6	8	9	19	160	58	12	2	12	14
4	138	130	30	7	8	5	20	172	51	14	3	10	19
5	132	142	28	1	9	9	21	112	45	15	3	10	14
6	132	142	28	1	9	8	22	122	34	15	4	10	14
7	138	155	28	1	9	14	23	134	39	15	4	10	19
8	183	140	24	0	9	11	24	122	39	15	5	10	19
9	164	140	24	0	11	12	25	112	39	11	2	10	19
10	158	85	20	0	12	9	26	146	42	10	2	10	19
11	158	76	20	0	9	9	27	192	39	10	3	14	24
12	151	68	20	0	9	12	28	134	39	10	3	11	19
13	164	76	19	0	10	9	29	118	37	10	5	8	19
14	145	94	19	1	10	9	30	107	37	10	5	8	19
15	151	76	19	1	10	8	31	97	......	10	6	......	19
16	158	60	19	1	10	12							

NOTE.—These discharges were obtained by the indirect method for shifting channels.

Monthly discharge of Sycan River near Silverlake, Oreg., for 1905.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	192	97	146	8,980
June	155	34	75.0	4,460
July	33	10	18.9	1,160
August	10	0	2.87	176
September	14	6	9.67	575
October	24	5	13.4	824
The period				16,200

NOTE.—These values are fair.

LOST RIVER NEAR CLEAR LAKE, CAL.

This station was established September 1, 1904. It is located about 2 miles downstream from Jessie D. Carr's Clear Lake dam, a short distance below the dam site for Clear Lake reservoir, about 20 miles from Tule Lake post-office, Cal. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 233, where are given also references to publications that contain data for previous years.

Discharge measurements of Lost River near Clear Lake, Cal., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Dis-charge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 2	C. T. Darley	102	95	6.18	146
March 3	do	102	93	6.25	157
March 6	do	125	141	6.60	235
March 7	do	127	203	7.18	452
March 8	do	135	238	7.35	534
March 9	do	126	204	7.18	460
March 27	do	148	407	8.80	1,330
April 3	do	150	421	9.00	1,480
April 6	do	150	449	9.16	1,610
April 17	do	148	376	8.50	1,270
April 24	L. F. Hendricks	135	246	7.50	626
May 2	do	125	168	6.90	365
June 14	do	65	60	5.80	58
July 15	do	16	16	5.20	13.9
October 30	do	18	13	5.20	10.2

Daily gage height, in feet, of Lost River near Clear Lake, Cal., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.2	5.5	6.45	9.3	6.95	6.45	5.25	5.1	5.1	5.2	5.2	5.3
2	5.2	5.5	6.15	9.1	6.85	6.3	5.2	5.1	5.1	5.2	5.2	5.3
3	5.2	5.5	6.2	9.0	6.8	6.3	5.2	5.1	5.1	5.2	5.2	5.3
4	5.2	5.5	6.15	9.6	6.75	6.3	5.1	5.1	5.1	5.2	5.3	5.3
5	5.2	5.5	6.2	9.05	6.5	6.3	5.05	5.1	5.1	5.2	5.3	5.3
6	5.2	5.5	6.55	9.1	6.45	6.4	5.6	5.1	5.1	5.2	5.3	5.3
7	5.2	5.5	7.1	9.25	6.4	6.6	5.6	5.1	5.1	5.2	5.3	5.3
8	5.2	5.5	7.25	9.3	6.35	6.55	5.0	5.1	5.1	5.2	5.3	5.3
9	5.2	5.5	7.2	9.4	6.3	6.45	5.0	5.1	5.1	5.2	5.3	5.3
16	5.2	5.5	7.4	9.4	6.25	6.2	5.6	5.1	5.1	5.2	5.3	5.35
11	5.3	5.5	7.8	9.3	6.25	6.2	5.3	5.1	5.1	5.2	5.3	5.4
12	5.3	5.5	7.75	9.3	6.2	6.1	5.25	5.1	5.1	5.2	5.3	5.45
13	5.3	5.5	7.75	9.2	6.2	6.1	5.2	5.1	5.2	5.2	5.3	5.45
14	5.4	5.5	7.75	9.0	6.2	6.0	5.2	5.1	5.2	5.2	5.3	5.5
15	5.4	5.75	7.75	8.75	6.2	5.9	5.2	5.1	5.2	5.2	5.3	5.5
16	5.5	5.85	7.75	8.5	6.2	5.85	5.2	5.1	5.2	5.2	5.3	5.5
17	5.55	5.8	7.75	8.4	6.2	5.85	5.2	5.1	5.2	5.2	5.3	5.6
18	5.55	5.8	7.85	8.2	6.2	5.8	5.2	5.1	5.2	5.2	5.3	5.6
19	5.55	6.6	8.0	8.0	6.1	5.7	5.15	5.1	5.2	5.2	5.3	5.7
20	5.55	6.7	8.1	7.8	6.1	5.6	5.15	5.1	5.2	5.2	5.3	5.7
21	5.55	6.8	8.2	7.7	6.05	5.5	5.15	5.1	5.2	5.2	5.3	5.8
22	5.55	6.85	8.3	7.65	6.05	5.5	5.1	5.1	5.2	5.2	5.3	5.8
23	5.55	6.55	8.4	7.55	6.05	5.4	5.1	5.1	5.2	5.2	5.3	5.8
24	5.5	6.25	8.5	7.55	6.0	5.35	5.1	5.1	5.2	5.2	5.3	6.15
25	5.5	6.0	8.7	7.4	6.0	5.3	5.1	5.1	5.2	5.2	5.3	6.8
26	5.5	6.2	8.8	7.25	6.0	5.4	5.1	5.1	5.2	5.2	5.3	7.2
27	5.5	6.9	8.8	7.2	6.2	5.45	5.1	5.1	5.2	5.2	5.3	7.35
28	5.5	6.6	8.8	7.1	6.4	5.35	5.1	5.1	5.2	5.2	5.3	7.3
29	5.5	....	8.75	7.0	6.5	5.35	5.1	5.1	5.2	5.2	5.3	7.15
30	5.5	....	8.8	7.0	6.6	5.35	5.1	5.1	5.2	5.2	5.3	7.0
31	5.5	....	9.3	....	6.6	....	5.1	5.1	....	....	....	7.0

Rating table for Lost River near Clear Lake, Cal., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.00	5	5.80	66	6.60	252	7.40	562	8.40	1,100
5.10	8	5.90	81	6.70	286	7.50	608	8.60	1,230
5.20	12	6.00	98	6.80	320	7.60	654	8.80	1,360
5.30	17	6.10	118	6.90	356	7.70	702	9.00	1,500
5.40	23	6.20	140	7.00	392	7.80	755	9.20	1,640
5.50	30	6.30	164	7.10	432	7.90	810	9.40	1,785
5.60	40	6.40	191	7.20	474	8.00	865		
5.70	52	6.50	220	7.30	518	8.20	980		

NOTE.—This table is based on 15 discharge measurements made during 1906 and is well defined between gage heights 5.2 feet and 9.1 feet.

Monthly discharge of Lost River near Clear Lake, Cal., for 1906.

Month.	Discharge in second-feet			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	35	12	23.6	1,450
February	356	30	106	5,890
March	1,710	120	797	49,000
April	1,780	392	1,150	68,400
May	374	98	177	10,900
June	282	17	99.2	5,900
July	17	5	9.4	578
August	8	8	8.0	492
September	12	8	10.4	619
October	12	12	12.0	738
November	17	12	16.5	982
December	540	17	127	7,810
The year	1,780	5	211	153,000

NOTE.—Values are rated as follows: March to May, excellent; August to November, fair; remainder of 1906, good.

LOST RIVER NEAR MERRILL, OREG.

This station was established July 26, 1904. It is located about 1½ miles downstream from the Stukel Bridge, 4 miles northwest of Merrill, Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 236, where are given also references to publications that contain data for previous years.

Discharge measurements of Lost River near Merrill, Oreg., in 1906.

Date.	Hydrographer	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 27	C. T. Darley	91	168	4.30	535
March 25	do	130	908	10.75	2,620
March 27	R. Hubbard	146	1,120	12.08	3,470
March 27	do	146	1,140	12.22	3,570
March 28	do	146	1,150	12.17	3,760
March 28	do	145	1,110	12.06	3,530
March 28	do	145	1,119	12.02	3,570
March 29	do	144	1,090	11.62	3,510
March 29	do	142	1,030	11.34	3,320
March 30	do	142	970	11.04	3,080
April 1	do	149	1,260	13.05	4,090
April 1	do	149	1,270	13.18	4,190
April 2	do	152	1,350	13.65	4,270
April 2	do	152	1,350	13.66	4,560
April 10	C. T. Darley	149	1,300	13.02	3,940
April 13	do	145	1,100	11.92	3,160
April 14	do	136	984	11.23	2,850
April 18	do	138	824	9.80	2,360
April 19	do	136	735	9.26	2,110
April 20	L. F. Hendricks	132	563	8.32	1,320
April 25	C. T. Darley	112	414	6.60	1,160
April 26	do	112	406	6.50	1,110
April 30	L. F. Hendricks	110	379	5.90	1,010
May 5	do	105	241	4.80	563
May 29	do	90	184	4.10	237
June 19	do	92	146	3.98	217
September 10	do	87	83	3.50	87

Daily gage height, in feet, of Lost River near Merrill, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	3.3	4.55	12.9	5.6	4.45	3.7	3.55	3.5	3.5	3.4	3.4
2	3.3	3.3	5.2	13.6	5.3	4.45	3.7	3.55	3.5	3.5	3.4	3.4
3	3.3	3.3	5.0	12.7	5.05	4.5	3.7	3.55	3.5	3.5	3.4	3.4
4	3.3	[a]3.3	4.6	11.5	5.0	4.3	3.7	3.55	3.5	3.5	3.4	3.4
5	3.3	[a]3.3	4.35	10.6	4.85	4.3	3.7	3.55	3.5	3.5	3.4	3.4
6	3.3	[a]3.4	4.2	10.45	4.65	4.25	3.7	3.55	3.5	3.5	3.4	3.4
7	3.3	3.4	4.1	11.0	4.6	4.2	3.7	3.5	3.5	3.5	3.4	3.4
8	3.3	3.4	4.1	11.75	4.6	4.3	3.65	3.5	3.5	3.5	3.4	3.4
9	3.3	3.4	4.65	12.4	4.5	4.3	3.65	3.5	3.5	3.5	3.4	3.4
10	3.3	3.4	5.8	13.0	4.45	4.3	3.6	3.5	3.5	3.5	3.4	3.4
11	3.3	3.4	6.3	13.5	4.35	4.4	3.6	3.5	3.5	3.5	3.4	3.4
12	3.3	3.4	6.7	13.05	4.25	4.15	3.7	3.5	3.5	3.5	3.4	3.45
13	3.3	3.4	5.85	12.1	4.2	4.15	3.7	3.55	3.5	3.5	3.4	3.45
14	3.3	3.45	5.5	11.2	4.3	4.1	3.6	3.55	3.5	3.5	3.4	3.45
15	3.3	3.45	5.9	10.55	4.2	4.2	3.6	3.55	3.5	3.5	3.4	3.45
16	3.3	3.5	5.2	10.1	4.15	4.2	3.6	3.5	3.5	3.5	3.4	3.45
17	3.3	3.5	4.9	9.95	4.2	4.0	3.6	3.55	3.5	3.5	3.4	3.45
18	3.3	3.6	4.5	9.9	4.25	3.9	3.6	3.55	3.5	3.5	3.4	3.45
19	3.3	3.8	4.4	9.25	4.15	3.95	3.6	3.55	3.5	3.5	3.4	3.45
20	3.3	4.0	4.35	8.45	4.05	3.85	3.6	3.55	3.5	3.5	3.4	3.45
21	3.3	4.45	4.45	7.95	4.1	3.85	3.6	3.55	3.5	3.5	3.4	3.45
22	3.3	5.15	4.75	7.4	4.05	3.8	3.6	3.5	3.5	3.5	3.4	3.45
23	3.3	5.2	5.5	7.1	4.1	3.85	3.6	3.5	3.5	3.5	3.4	3.45
24	3.3	5.3	8.9	6.85	4.0	3.85	3.55	3.55	3.5	3.5	3.4	3.45
25	3.3	4.9	10.8	6.6	4.2	3.8	3.55	3.55	3.5	3.5	3.4	3.5
26	3.3	4.5	11.4	6.5	4.1	3.8	3.55	3.55	3.5	3.5	3.4	3.5
27	3.3	4.3	12.1	6.5	4.05	3.8	3.55	3.55	3.5	3.5	3.4	3.65
28	3.3	4.3	12.1	6.25	4.05	3.8	3.55	3.55	3.5	3.5	3.4	4.85
29	3.3	....	11.5	5.85	4.1	3.7	3.55	3.5	3.5	3.5	3.4	5.6
30	3.3	....	11.05	5.9	4.15	3.7	3.55	3.5	3.5	3.5	3.4	5.2
31	3.3	....	11.5	....	4.25	....	3.55	3.5	....	3.5	....	4.8

[a] Estimated.

Rating tables for Lost River near Merrill, Oreg.

JANUARY 1 TO MAY 17, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.30	102	4.50	467	5.70	887	6.80	1,272	8.80	2,006
3.40	125	4.60	502	5.80	922	6.90	1,307	9.00	2,080
3.50	150	4.70	537	5.90	957	7.00	1,342	9.20	2,160
3.60	176	4.80	572	6.00	992	7.20	1,414	9.40	2,240
3.70	203	4.90	607	6.10	1,027	7.40	1,488	9.60	2,320
3.80	232	5.00	642	6.20	1,062	7.60	1,562	9.80	2,400
3.90	262	5.10	677	6.30	1,097	7.80	1,636	10.00	2,480
4.00	294	5.20	712	6.40	1,132	8.00	1,710	11.00	2,950
4.10	328	5.30	747	6.50	1,167	8.20	1,784	12.00	3,440
4.20	362	5.40	782	6.60	1,202	8.40	1,858	13.00	4,000
4.30	397	5.50	817	6.70	1,237	8.60	1,932	14.00	4,630
4.40	432	5.60	852						

MAY 18 TO DECEMBER 31, 1906.[b]

3.40	66	3.90	185	4.40	342	4.90	511	5.30	650
3.50	87	4.00	215	4.50	375	5.00	545	5.40	685
3.60	108	4.10	246	4.60	409	5.10	580	5.50	720
3.70	131	4.20	278	4.70	443	5.20	615	5.60	755
3.80	157	4.30	310	4.80	477				

[a] This table is based on discharge measurements made during 1904-1906 and is well defined.

[b] This table is based on 3 discharge measurements made during 1906 and is well defined between gage heights 3.5 feet and 4.1 feet.

Monthly discharge of Lost River near Merrill, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	102	102	102	6,270
February	747	102	259	14,400
March	3,500	328	1,260	77,500
April	4,380	940	2,540	151,000
May	852	215	386	23,700
June	375	131	240	14,300
July	131	98	113	6,950
August	98	87	93.7	5,760
September	87	87	87.0	5,180
October	87	87	87.0	5,350
November	66	66	66.0	3,930
December	755	66	130	7,990
The year	4,380	66	447	186,400

NOTE.—These values are excellent except for May, which is good.

TULE LAKE NEAR MERRILL, OREG.

This station was established May 17, 1904, for recording the water level in Tule Lake. It is located on Tule Lake at the mouth of Lost River about 3 miles east of Merrill, Oreg., 25 miles south from Klamath Falls, and near the Oregon-California line. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 238.

Daily gage height, in feet, of Tule Lake near Merrill, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1				7.75		9.0	8.85	8.4	7.75	7.4	7.15	7.0
2		6.65	6.8									
5	6.5											
7				8.4					7.7			
8					9.1			8.2				7.1
9		6.65	6.95			9.0	8.8			7.3		
10											7.15	
11	6.5											
13						9.0						
15									7.6			
16			7.1	8.85	9.1		8.7	8.05				
18												7.25
19										7.2		
20											7.15	
21						8.9						
22				9.0				7.85	7.5			
23	6.7						8.45					
24			7.3		9.05							
25			7.4									7.3
28								7.8				
30			7.7	9.1		8.85	8.4		7.4		7.0	
31					9.0			7.8		7.15		7.35

MILLER CREEK NEAR LORELLA, OREG.

This station was established August 10, 1904. It is located at the Horsefly dam site, 10 miles northeast of Lorella, Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 239, where are given also references to publications that contain data for previous years.

Discharge measurements of Miller Creek near Lorella, Oreg., by L. F. Hendricks, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft*	*Feet*	*Sec.-ft.*
March 27	140	225	8.65	883	April 6	140	298	9.28	1,240
March 28[a]	140	243	8.65	884	April 9	160	517	10.65	2,550
March 29	140	271	8.80	1,040	April 10	150	389	9.72	1,690
March 30	140	340	9.50	1,440	April 22	125	127	7.55	308
March 30	150	411	10.10	1,940	April 25	130	129	7.62	309
April 4	140	188	8.25	629	July 14			5.80	0
April 5	140	284	9.00	1,110					

[a] Measured by C. T. Darley.

Daily gage height, in feet, of Miller Creek near Lorella, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Nov.	Dec.
1	6.2	6.3	7.0	8.1	7.0	7.2	6.15		6.1
2	6.2	6.3	7.1	8.1	7.0	7.0	6.15		6.1
3	6.2	6.3	7.1	8.4	6.9	6.9	6.1		6.1
4	6.2	6.3	7.05	8.15	6.8	6.9	6.1		6.1
5	6.2	6.3	7.0	9.2	6.7	7.0	6.05		6.2
6	6.2	6.3	7.05	9.5	6.7	7.3	6.05		6.2
7	6.3	6.3	7.2	9.9	6.7	7.2	6.0		6.35
8	6.3	6.3	7.5	9.9	6.6	7.2	6.0		6.4
9	6.4	6.3	7.7	10.5	6.6	7.1			6.3
10	6.4	6.3	7.8	10.0	6.5	7.0			6.3
11	6.4	6.3	7.7	9.1	6.5	6.9			6.3
12	6.3	6.3	7.6	8.8	6.5	6.8			6.2
13	6.3	6.3	7.5	8.8	6.6	6.8			6.2
14	6.3	6.3	7.3	8.7	6.7	6.7			6.2
15	6.3	6.3	7.1	8.7	6.7	6.6			6.2
16	6.3	6.3	6.9	8.9	6.7	6.5			6.2
17	6.3	6.3	6.7	8.5	6.7	6.5			6.2
18	6.3	6.3	6.7	8.1	6.6	6.4		6.1	6.2
19	6.3	6.3	6.7	7.9	6.6	6.4		6.1	6.2
20	6.3	6.3	6.7	7.8	6.5	6.3		6.1	6.25
21	6.3	6.3	7.2	7.7	6.5	6.3		6.1	6.3
22	6.3	6.3	7.8	7.5	6.5	6.2		6.1	6.3
23	6.3	6.3	8.3	7.5	6.5	6.2		6.1	6.4
24	6.3	6.2	8.8	7.4	6.5	6.1		6.1	6.6
25	6.3	6.4	9.7	7.5	6.4	6.1		6.1	7.65
26	6.3	6.6	9.0	7.4	6.5	6.1		6.1	8.35
27	6.3	6.7	8.6	7.3	6.8	6.1		6.1	7.95
28	6.3	6.8	8.65	7.4	7.1	6.15		6.1	7.4
29	6.3		8.65	7.4	7.5	6.15		6.1	7.4
30	6.3		9.7	7.2	7.5	6.15		6.1	6.8
31	6.3		9.6		7.4				6.6

NOTE.—The creek was dry July 7 to November 17.

Rating table for Miller Creek near Lorella, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.00	0	6.80	52	7.60	290	8.40	715	9.40	1,415
6.10	1.5	6.90	67	7.70	337	8.50	775	9.60	1,575
6.20	4	7.00	86	7.80	387	8.60	835	9.80	1,745
6.30	8	7.10	109	7.90	437	8.70	900	10.00	1,915
6.40	13	7.20	136	8.00	490	8.80	965	10.20	2,085
6.50	20	7.30	168	8.10	545	8.90	1,035	10.40	2,265
6.60	29	7.40	205	8.20	600	9.00	1,110		
6.70	39	7.50	245	8.30	655	9.20	1,260		

NOTE.—This table is based on discharge measurements made during 1904–1906 and is well defined.

Monthly discharge of Miller Creek near Lorella, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	13	4	7.7	474
February	52	4	11.5	639
March	1,660	39	445	27,460
April	2,360	136	779	46,400
May	245	13	56.7	3,490
June	168	1.5	47.3	2,810
July	2.8	0	0.3	18
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	1.5	0	0.6	36
December	685	1.5	68.1	4,190
The year	2,360	0	118	85,500

NOTE.—Values are rated as follows: March to May and December, excellent; January, February, and June, good. July and November, fair.

MISCELLANEOUS MEASUREMENTS IN KLAMATH RIVER DRAINAGE BASIN.

Cherry Creek (North Fork) near Crystal, Oreg.—This stream is tributary to Upper Klamath Lake from the west. A measurement was made September 1, 1906, near the crossing on the road from Fort Klamath to Pelican Bay:

Width, 9.5 feet; area, 5.8 square feet; discharge, 9.4 second-feet.

Cottonwood Creek near Brownell, Cal.—Cottonwood Creek is tributary to Lower Klamath Lake from the south. The following measurements were made during 1906 at Brownell's "F" ranch:

February 13: Width, 22 feet; area, 25 square feet; discharge, 14 second-feet.
September 26: Width, 25 feet; area, 32 square feet; discharge, 12.2 second-feet.

Crooked Creek near Klamath Agency, Oreg.—This stream is a tributary of Wood River. A measurement was made August 31, 1906. at the bridge 1½ miles from Klamath Agency on the road to Fort Klamath:

Width, 31 feet; area, 94 square feet; discharge, 59 second-feet.

Doris Creek near Doris, Cal.—Doris Creek is tributary to Lower Klamath Lake from the southwest. The following measurements were made during 1906 at Doris ranch:

March 22: Width, 5.4 feet; area, 7.4 square feet; discharge, 11.6 second-feet.
February 14: Width, 5.5 feet; area, 5.1 square feet; discharge, 8 second-feet.
September 26: Width, 13 feet; area, 13.7 square feet; discharge, 8.4 second-feet.

Fort Creek near Fort Klamath, Oreg.—This stream is a tributary of Wood River. A measurement was made August 31, 1906, at the bridge 2 miles southeast from Fort Klamath on the road between Klamath Agency and Fort Klamath:

Width, 42 feet; area, 104 square feet; discharge, 115 second-feet.

Rock Creek near Odessa, Oreg.—This stream is tributary to Upper Klamath Lake from the west. A measurement was made September 3, 1906, at road crossing 7 miles below Odessa on the road from Odessa to Klamath Falls:

Width, 14 feet; area, 9.8 square feet; discharge, 12.8 second-feet.

Sevenmile Creek near Fort Klamath, Oreg.—This creek is tributary to Upper Klamath Lake. A measurement was made September 1, 1906, at the bridge on the road between Fort Klamath and Pelican Bay:

Width, 29 feet; area, 99 square feet; discharge, 83 second-feet.

Spring Creek near Klamath Agency, Oreg.—This stream is a small tributary of Crooked Creek. A measurement was made August 31, 1906, at the bridge 1 mile from Klamath Agency on the road to Fort Klamath:

Width, 22 feet; area, 42 square feet; discharge, 27 second-feet.

Willow Creek near Brownell, Cal.—Willow Creek is tributary to Lower Klamath Lake from the south. The following measurements were made during 1906 near the bridge on the Merrill and Brownell road:

February 13: Width, 18 feet; area, 13 square feet; discharge, 13 second-feet.
March 24: Width, 20.5 feet; area, 15.5 square feet; discharge, 17.2 second-feet.
September 26: Width, 35 feet; area, 26 square feet; discharge, 13 second-feet.

Wood River near Fort Klamath, Oreg.—Wood River is tributary to Upper Klamath Lake from the north. The following measurements were made August 30, 1906, at the bridge at Fort Klamath, Oreg.:

Width, 54 feet; area, 175 square feet; discharge, 257 second-feet.

At the bridge on the county road 4 miles below Fort Klamath, Oreg.:

Width, 55 feet; area, 313 square feet; discharge, 462 second-feet.

Williamson River near Klamath Agency, Oreg.—This stream is tributary to Upper Klamath Lake from the north. A measurement was made August 29 at the bridge on the county road between Klamath Falls and Fort Klamath, Oreg.:

Width, 162 feet; area, 1,348 square feet; discharge, 880 second-feet.

PRECIPITATION AND EVAPORATION DATA.

The following table gives the total precipitation and evaporation in inches, by months, and also the annual totals, for 1906:

Precipitation and evaporation in Klamath River basin.

PRECIPITATION.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Annual.
Keno, Oreg.	6.94	1.40	2.94	0.67	2.33	1.18	1.26	0.14	0.66	0.89	1.90	2.79	23.10
Clear Lake, Oreg.	4.00	2.07	3.62	.09	2.7	1.05	.60	.00	.76	.41	2.05	3.70	21.05
Horse-fly, near Lorella, Oreg.	9.47	4.00	6.65	.52	1.88	1.45	.00	.00	.67	......	......	......	....

EVAPORATION.

Keno, Oreg.	(a)	(a)	(a)	3.03	4.58	4.04	5.87	4.69	[b]3.27	2.22	(a)	(a)	....

[a] Wind and ice destroys record.

[b] October 1 to 27, inclusive.

FLUCTUATIONS IN GROUND-WATER LEVELS IN THE VALLEY OF SOUTHERN CALIFORNIA.

By W. C. MENDENHALL.

In the summer of 1903 the United States Geological Survey undertook a systematic study of the occurrence, distribution, and proper use of the ground waters in the valley of southern California. During the preceding decade the underground waters of this part of California had been extensively drawn on as a source of supply for irrigation and for municipal use. Many independent enterprises were established which depended entirely on them, while older systems dependent in the beginning on gravity waters had found it necessary to augment their supply by utilizing subsurface waters. As a result of all this development—greater in the citrus regions, where the large values of the products raised by irrigation made it possible to pay high prices for water; somewhat less in the lower lands, suitable only for the cultivation of alfalfa or other farm products, which yield less profits than those from the horticultural lands—marked effects were produced on ground-water levels and on the yield of wells. It became evident, therefore, that any thorough study of conditions controlling the proper use of ground waters should involve the consideration of definite evidence as to their fluctuations and as to the relation of the fluctuations to development on the one hand and to the supply derived from annual rainfall on the other. During the decade of dry years which preceded 1903 it was evident that artesian areas had decreased, that the flow of individual wells had lessened, and that ground-water levels had been generally lowered; but definite observations as to the amount of these shrinkages for comparison with rainfall records were lacking except for a few wells. The Riverside Trust Company, the present owners of the Gage canal system and of the wells from which its water supplies are drawn, had maintained since 1892 a series of systematic measurements of variations of water level in the Williams well on the Victoria tract, and Mr. J. B. Neff, of Anaheim, had maintained a similar series of measurements since 1898. Here and there throughout the valley of southern California scattered data were found bearing on the problem, but only in these two localities had systematic and continuous observations been made.

Because the ground waters of southern California occur not in one great basin but in a series of more or less completely separated subterranean reservoirs, the supply in each being dependent upon the relation between local development and local tributary rainfall, general conclusions that were applicable everywhere could not safely be based on the records furnished by the Williams and Neff wells. It was therefore decided, in the autumn of 1904, to begin an independent series of measurements in wells so selected that they would be evenly distributed over the various basins which together make up the lowland areas of southern California and would thus give an adequate basis for conclusions as to conditions in each of these basins. For this purpose a number of wells were selected in localities distributed from Santa Monica to San Bernardino and San Jacinto. The attempt was made to select wells in each of the important local ground-water districts which would adequately represent the various conditions that exist in each of these districts. Wells have been selected which are close to the larger river beds and therefore fluctuate rapidly through a wide range with flood-water and low-water periods, and other wells have been selected which are remote from these local sources of supply and which on this account exhibit comparatively minor variations. Some of these observation wells are situated in the vicinity of groups of large pumping plants; others are at points which are comparatively remote from these centers of great development, while still others were so selected as to form a series, like that in the El Monte basin, extending back from a stream channel, the line of most effective recharge, thereby enabling the student of ground-water supplies to trace the percolation wave and observe its diminishing intensity and amplitude as it advances from its point of origin. It is believed, therefore, that practically all conditions are well represented in the measurements which have been obtained.

At the time of the beginning of these measurements southern California was near the end of a long period of low rainfall, during which ground-water levels had materially declined. Since the beginning of measurements, however, there have been two winters in which the rainfall reached from 20 to 30 per cent above the average, and the present winter—that of 1906–7—it seems, will maintain this high average. Under these conditions, since ground waters are dependent as absolutely if not as obviously on rainfall as are surface waters, there should be a marked and general rise of the ground-water plane if withdrawals are not in excess of the average annual restoration. Under conservative use of these waters the ground-water levels will decline during the dry periods but will recover correspondingly during the wet years. Continuous declines during seasons of excessive precipitation mean overuse.

A few of the results of these measurements have been discussed in Water-Supply Paper No. 218, which treats of ground-water conditions in the foothill belt only; but in order that all the observations made may be available for engineers and others who are interested in ground-water problems in southern California, they are more fully presented in the tables that follow.

A simple black and white index map (Pl. IV), on which the location of each record well is shown, accompanies the tables. On this map the wells are numbered, and corresponding numbers are given each record.

In order to facilitate still further the identification of the wells the name of the owner of nearly everyone of them is given, as well as the approximate position of each in relation to a near-by town.

Tables showing variations of water level in wells in southern California.

1. R. Kidson, ¾ mile NE. of Slauson.			2. Chinese gardeners, ½ mile SW. of Slauson.			3. Eliza Connelly, 1½ miles N. of Sunnyside.		
Date of measurement.	Depth to water.		Date of measurement.	Depth to water.		Date of measurement.	Depth to water.	
1905.	*Ft.*	*in.*	1904.	*Ft.*	*in.*	1905.	*Ft.*	*in.*
Jan. 3	44	1	Sept. 1	25	2½	Jan. 3	22	5
Feb. 6	44	6	Oct. 3	22	4½	Feb. 6	22	6
Mar. 14	44	4	Nov. 4	22	7½	Mar. 14	21	11
Apr. 10	44	1	Dec. 6	22	2	Apr. 10	21	6
June 9	44	4				May 3	21	5
July 10	44	9	1905.			June 9	22	7½
Aug. 8	45	3	Jan. 3	21	10	July 10	23	6
Sept. 11	45	11	Feb. 6	21	9	Nov. 3	23	10
Nov. 3	46	2	Mar. 14	21	1½	Dec. 14	23	½
Dec. 14	45	10	Apr. 10	20	5			
			May 3	20	5	1906.		
1906.			June 10	24	6	Mar. 19	22	6
Jan 22	46	10	July 10	23	0	May 2	22	7½
Mar. 19	47	7½	Aug. 8	24	0	June 21	23	9½
May 2	44	11	Sept. 11	24	7	Sept. 17	24	4½
June 21	47	10	Nov. 3	23	6	Dec. 14	23	7
July 27	46	2	Dec. 14	23	½			
Sept. 17	46	6½						
Dec. 14	46	8	1906.					
			Jan. 22	22	6			
			Mar. 19	22	1			
			June 21	23	6½			
			May 2	23	1			
			July 27	24	½			
			Sept. 17	25	3			
			Dec. 14	23	8½			

Tables showing variations of water level in wells in southern California—Continued.

4. Mr. Till. 2½ miles S. of Slauson.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Sept. 1	29	10
Oct. 3	32	1½
Dec. 6	31	11
1905.		
Jan. 2	29	7
Feb. 6	29	6
Mar. 14	29	1
Apr. 10	28	7
May 3	28	8
June 9	29	4
July 10	29	5
Aug. 8	30	1
Sept. 11	30	6
Nov. 3	30	6
Dec. 14	30	6
1906.		
Jan. 22	30	5
Mar. 19	30	7½
May 2	30	9
June 21	30	7
July 27	31	0
Sept. 17	32	8
Dec. 14	31	4½

5. J. P. Brockley. ¾ mile N. of Howard Summit.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904		
Oct. 3	83	7
Nov. 4	83	9
Dec. 6	83	9
1905.		
Jan. 3	83	8
Feb. 6	83	8
Mar. 14	83	5
Apr. 10	83	5
May 3	83	4
June 9	83	8
July 10	84	2
Aug. 8	84	7½
Sept. 11	84	11
Nov. 3	85	1
Dec. 14	84	9
1906.		
Jan. 22	84	4½
Mar. 19	84	6½
May 2	83	4
June 21	85	2½
July 27	85	1
Sept. 17	85	9
Dec. 14	87	2

6. F. H. Carrell, 1¼ miles SW. of Gardena.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Dec. 6	27	1
1905.		
Jan. 3	26	5
Feb. 6	25	7½
Mar. 14	25	7
Apr. 12	25	8
May 3	25	8
June 9	26	4
July 10	29	9
Aug. 8	29	10
Sept. 11	29	7
Nov. 3	28	0
Dec. 14	26	6½
1906.		
Jan. 22	26	2
Mar. 19	25	1
May 2	26	8
June 21	28	10
July 27	30	1
Sept. 17	29	8
Dec. 14	26	11

7. A. B. Caldwell, ¼ mile S. of Moneta.

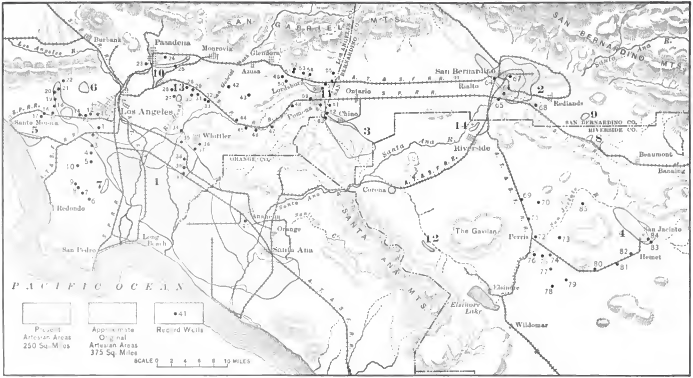
Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Sept. 1	41	11
Oct. 3	32	6
Nov. 4	38	11
Dec. 6	25	7
1905.		
Jan. 3	26	5
Feb. 6	41	9
Mar. 14	23	10
Apr. 10	48	2
May 3	42	10
June 9	32	2
July 10	33	0
Aug. 8	32	6
Sept. 11	33	0
Nov. 3	28	4
Dec. 14	24	11
1906.		
Jan. 22	24	6
Mar. 19	23	8
May 2	27	11
June 21	32	3
July 27	32	6½
Sept. 17	30	8½
Dec. 14	25	0

8. H. J. Harris, ½ mile N. of Moneta.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Sept. 1	39	3
Oct. 3	37	9
Nov. 4	35	0
Dec. 6	32	4
1905.		
Jan. 3	26	5½
Feb. 6	25	11
Mar. 14	25	8½
Apr. 10	32	8
May 3	28	3
June 9	35	2
July 10	33	9
Aug. 8	33	7
Sept. 11	34	5
Dec. 14	26	7
1906.		
Jan. 22	26	0
Mar. 19	23	7
May 2	28	0
June 21	28	6
July 27	34	0
Sept. 17	34	0
Dec. 14	26	2

9. Stanley Bates, ¾ mile NW. of Moneta.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Dec. 6	36	4
1905.		
Jan. 3	36	1
Feb. 6	35	5
Mar. 14	35	3
Apr. 10	35	1
May 3	35	3
June 9	36	0
July 10	36	8½
Aug. 8	37	1½
Sept. 11	37	4
Nov. 3	37	0
Dec. 14	36	3½
1906.		
Jan. 22	36	0
Mar. 19	34	0
May 2	33	4½
June 21	32	3
July 27	39	2
Sept. 17	39	2
Dec. 14	36	3



MAP OF VALLEY OF SOUTHERN CALIFORNIA, SHOWING LOCATION OF WELLS SELECTED TO SHOW GROUND-WATER CONDITIONS.

Tables showing variations of water level in wells in southern California—Continued.

10. Post and Lockhart, 2 miles W. of Howard Summit.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Dec. 6	35 7½
1905.	
Jan. 3	36 0
Feb. 6	38 6
Mar. 14	27 4
Apr. 10	35 8
May 3	35 0
July 10	38 6
Aug. 8	40 3
Sept. 11	47 4
Dec. 14	39 3
1906.	
Jan. 22	36 0
Mar. 19	34 3
May 2	33 4½
June 21	38 2
July 27	37 10
Sept. 17	37 10½
Dec. 14	37 1½

11. William Bayley, Chester place, Los Angeles.

Date of measurement.	Depth to water
1904.	*Ft. in.*
Dec. 0	69 0
1905.	
Jan. 6	69 2½
Feb. 10	69 5
Mar. 18	69 0
Apr. 10	69 8
May 6	69 8
June 10	69 8
July 11	69 10
Aug. 9	70 0
Sept. 12	70 1½
Nov. 4	70 4
Dec. 15	70 5½
1906.	
Jan. 23	70 6½
Mar. 20	70 4
May 3	70 6½
June 23	70 7
July 28	70 7
Sept. 18	70 9
Dec. 15	71 0

12. Tony Bright, W. Jefferson street, Los Angeles.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Dec. 9	48 6
1905.	
Jan. 6	48 8
Feb. 10	48 10
Mar. 18	48 8½
Apr. 10	48 4
May 6	48 1
June 10	48 6
July 11	48 10½
Aug. 9	49 1½
Sept. 12	40 4½
Nov. 4	49 6
Dec. 15	49 8½
1906.	
Jan. 23	40 8
Mar. 20	49 4
May 3	49 4
June 22	49 6½
July 28	49 10
Sept. 18	50 1
Dec. 15	50 0

13. Mrs. Showers, W. Jefferson st., Los Angeles.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Oct. 3	33 8
Nov. 7	33 9
Dec. 9	33 6
1905.	
Jan 6	33 6
Feb. 10	33 0
Mar. 18	32 2½
Apr. 12	32 1
May 6	32 9
June 10	33 0
July 11	33 9
Aug. 9	34 4
Sept. 12	34 7
Nov. 4	34 9
Dec. 15	34 3
1906.	
Jan. 23	34 1
Mar. 20	33 3
May 3	33 6
June 22	33 11
May 3	33 6
June 22	33 11
July 28	34 7½
Sept. 18	35 3
Dec. 15	34 0

14. Artesian Land and Water Co., ½ mile N. of Cienega station.

Date of measurement.	Depth to water.
1905.	*Ft. in.*
Feb. 10	6 11
Mar. 17	5 8½
Apr. 13	5 10
May 6	6 1
June 10	7 2
July 11	7 0
Aug. 0	8 4
Sept. 12	8 9
Dec. 15	8 1
1906.	
Jan. 23	7 1
Mar. 20	7 10
May 3	7 3½
June 22	7 10
July 28	9 0
Sept. 18	9 6
Dec. 15	8 5½

15. Los Angeles County, Ivy station.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Dec. 0	13 11
1905.	
Jan. 6	13 0
Mar. 18	12 1
Apr. 13	12 0
June 10	12 3
July 11	12 7
Aug. 9	13 0
Sept. 12	13 4½
Nov. 4	13 3
Dec. 15	13 3½
1906.	
Jan. 23	13 1
Mar. 20	12 5
May 3	12 2
June 22	9 8½
July 28	12 10
Sept. 18	13 3
Dec. 15	13 3½

Tables showing variations of water level in wells in southern California—Continued.

16. M. P. Kane, Palms.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 1	50	8
Oct. 12	49	6
Nov. 7	49	6
Dec. 9	50	2
1905.		
Jan. 6	49	9
Mar. 18	49	4
Apr. 13	49	4
July 11	49	8
Aug. 9	49	11
Sept. 12	49	7
Dec. 15	49	5½
1906.		
Jan. 23	49	6
Mar. 20	49	2½
June 22	49	5
July 28	49	5½
Sept. 18	49	10
Dec. 15	49	11

17. F. P. Bojorquez, Palms.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 13	42	2½
Nov. 7	42	4
Dec. 9	45	5
1905.		
Jan. 6	42	9½
Mar. 18	43	3
Apr. 13	43	4½
May 6	43	6
June 10	43	6
July 11	43	8
Aug. 9	43	11
Sept. 12	44	1
Nov. 4	43	6
Dec. 15	45	7
1906.		
Jan. 23	44	5
Mar. 20	44	2
May 3	44	7
June 22	46	7
July 28	44	6½
Sept. 18	44	6
Dec. 15	44	8

18. Jose Sesma, 1 mile N. of Ivy station

Date of Measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Dec. 2	43	3
1905.		
Jan. 6	43	4½
Feb. 10	43	9
Mar. 18	43	6
Apr. 13	43	5
June 10	43	6
July 11	43	7
Aug. 9	43	8
Sept. 12	43	10
Nov. 4	42	9
Dec. 15	43	11½
1906.		
May 3	44	1½
June 22	45	2½
July 28	44	4
Dec. 15	44	7

19. J. H. Whitworth, 2 miles S. of Sherman.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Dec. 9	10	9
1905.		
Jan. 6	10	6
Feb. 10	9	9
Mar. 18	8	2
Apr. 13	8	0
May 6	8	4
June 10	9	2
July 11	9	0
Aug. 9	8	8
Nov. 4	9	7½
Dec. 15	9	4
1906.		
Jan. 23	8	9
Mar. 20	8	8
May 3	7	8½
June 22	9	5½
July 28	9	8½
Sept. 18	10	1
Dec. 15	8	7

20. Hammel and Decker, 1 mile S. of Sherman.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Dec. 9	13	6
1905.		
Jan. 6	13	6
Feb. 10	12	11½
Mar. 18	11	9
Apr. 13	11	6
May 6	11	7
June 10	11	10
July 11	12	1
Aug. 9	12	4
Sept. 12	12	10
Nov. 4	13	0
Dec. 15	12	10
1906.		
Jan 23	12	4½
Mar. 20	12	1½
May 3	11	9½
June 22	12	1
July 28	12	7½
Sept. 18	12	10½
Dec. 15	12	6

21. William Niles, ½ mile S. of Sherman.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 14	9	0
Nov. 7	9	2
Dec. 9	9	3
1905.		
Jan. 6	7	6
Feb. 10	6	2
Mar. 18	4	3
Apr. 13	6	6
May 6	6	8
June 10	7	0
July 11	8	2
Aug. 9	8	10
Sept. 12	9	5
Dec. 15	7	6
1906.		
Jan. 23	7	3
Mar. 20	7	4
May 3	7	8
June 22	8	5
July 28	8	2½
Sept. 18	9	6½
Dec. 15	7	2½

Tables showing variations of water level in wells in southern California—Continued.

22. Los Angeles County, 1 mile E. of Sherman.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Dec. 9	84	3½
1905.		
Jan. 6	84	5½
Feb. 10	84	6
Mar. 18	84	6
Apr. 13	84	4
May 6	84	3
June 10	84	6
July 11	84	6
Aug. 9	84	10
Sept. 12	85	2
Nov. 4	86	0
Dec. 15	86	9
1906.		
Jan. 23	84	6
Mar. 20	86	3
May 3	86	5
June 22	86	8½
July 28	87	5½
Sept. 18	87	8½
Dec. 15	88	1

23. Mr. Hurlbut, Pasadena.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Sept. 2	73	3
Oct. 5	73	10
Nov. 8	73	11
Dec. 10	74	6
1905.		
Jan. 4	74	6
Feb. 9	74	4
Apr. 12	73	8
May 10	73	5
June 13	73	5
July 12	74	0
Aug. 10	74	5
Sept. 13	75	0
Nov. 7	75	0
Dec. 18	75	9
1906.		
Mar. 22	74	6
May 5	74	9
June 25	74	6
July 31	75	3½
Sept. 20	76	1½
Dec. 17	77	1

24. L. V. Harkness, 1½ mile SE. of Pasadena.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Sept. 2	122	4
Oct. 5	122	2½
Nov. 8	122	7
Dec. 10	122	6½
1905.		
Feb. 9	122	2
Mar. 17	122	2
Apr. 12	122	2
May 10	122	1
June 13	122	4
July 12	123	3
Aug. 10	123	5
Sept. 13	124	0
Nov. 7	124	1
Dec. 18	123	7
1906.		
Jan. 24	123	3½
Mar. 22	123	2½
May 5	122	11
June 25	122	8
July 31	123	6½
Sept. 20	123	10
Dec. 17	123	1½

25. Titus ranch, Sunny Slope station.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Dec. 10	13	6
1905.		
Jan. 4	10	4½
Feb. 9	8	7
Mar. 17	8	6
Apr. 12	7	8
May 10	8	1
June 13	11	6
July 12	16	1
Aug. 10	19	2
Sept. 13	16	2
Nov. 7	12	10
Dec. 18	10	7
1906.		
Jan. 24	10	9
Mar. 22	10	0
June 25	8	6
May 5	8	4
May 5	8	4
July 31	18	3
Sept. 20	16	9½
Dec. 17	14	2½

26. John McClain estate, 1 mile S. of San Gabriel.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Dec. 10	72	11
1905.		
Jan. 4	72	10
Feb. 9	73	0
Mar. 17	72	10
Apr. 12	72	7
Juno 13	73	4
July 12	73	3
Aug. 10	74	1
Dec. 18	73	0
1906.		
Mar. 22	72	8½
May 5	72	7½
June 25	72	8
July 31	72	3½
Sept. 20	72	1
Dec. 17	71	4

27. F. E. Wilson, 2 miles S. of San Gabriel.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Dec. 10	23	5½
1905.		
Jan. 4	23	6
Feb. 7	23	3
Mar. 17	22	8½
Apr. 12	21	0
July 12	21	4
Aug. 10	22	6
Sept. 13	22	3
Nov. 17	22	8
Dec. 18	22	11
1906.		
Jan. 24	22	3
Mar. 22	23	0
May 5	22	8
June 25	21	8
July 31	21	4
Dec. 17	21	11

Tables showing variations of water level in wells in southern California—Continued.

28. G. B. Renfro, ¾ mile SW. of Savannah.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Dec. 9	19	6
1905.		
Jan. 4	20	1½
Feb. 9	20	0
Mar. 17	19	3
Apr. 12	18	4
May 10	17	8
June 13	18	7
July 12	18	11
Aug. 10	19	2
Sept. 13	20	0
Nov. 7	20	3
1906.		
Jan. 24	19	10
Mar. 22	18	11
May 5	18	1
June 25	18	4
July 31	18	8
Dec. 17	18	8

29. J. A. Law. ½ mile W. of El Monte.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Dec. 10	16	2
1905.		
Jan. 4	16	1½
Feb. 9	16	3
Mar. 17	13	8
Apr. 12	13	2
July 12	13	1
Aug. 10	13	5½
Sept. 13	14	4
Nov. 7	14	1
Dec. 18	13	9
1906.		
Jan. 24	13	8½
Mar. 22	12	6
May 5	11	8
June 25	11	5
July 31	11	10½
Sept. 20	12	2½
Dec. 17	11	9

30. M. Ritter, El Monte.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Nov. 8	22	5
Dec. 10	22	6½
1905.		
Jan. 4	22	6
Feb. 9	21	9
Mar. 17	20	1
Apr. 12	18	1
May 10	16	8
June 13	16	11
July 12	17	5
Aug. 10	16	8
Sept. 13	17	5
Nov. 7	18	2
Dec. 18	18	0
1906.		
Jan. 24	18	9½
Mar. 22	17	3
May 5	14	4
June 25	12	9½
July 31	12	11½
Sept. 20	14	1
Dec. 17	14	7½

31. Mrs. McClure, ¾ mile S. of El Monte.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1905.		
Jan. 4	16	6
Feb. 9	15	10
Mar. 17	14	2
July 12	12	5
Aug. 10	13	9
Sept. 13	14	8
Nov. 7	13	6
Dec. 18	13	6
1906.		
Jan. 24	13	1
Mar. 22	12	10
May 5	10	6
June 25	10	0
July 31	10	4½
Sept. 20	12	½
Dec. 17	10	.7

32. T. D. Andrews, 1½ mile SE. of El Monte.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Dec. 10	21	5½
1905.		
Jan. 4	21	5
Feb. 9	20	8
Mar. 17	17	10
Apr. 12	15	10
May 10	14	8
June 12	13	8
July 12	13	9
Aug. 10	15	9
Sept. 13	16	10
Nov. 7	17	3
Dec. 17	17	0
1906.		
Jan. 24	17	4
Mar. 22	15	4
May 5	12	8
June 25	11	9
July 31	12	2
Sept. 20	13	5½
Dec. 17	13	8

33. Jackson Frees, 2 miles SE. El Monte.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1905.		
Feb. 9	27	5
Mar. 17	23	4½
Apr. 12	20	2
May 10	20	8
June 13	18	6
July 12	19	9
Aug. 10	21	0
Sept. 13	22	4
Nov. 7	23	3
Dec. 18	22	9
1906.		
Jan. 24	19	10
Mar. 22	22	11
May 5	18	1½
June 25	18	1½
July 31	17	3
Sept. 20	18	9
Dec. 17	19	10

Tables showing variations of water level in wells in southern California—Continued.

34. E. Gurado 3 miles W. of Whittier.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 4	14	2
Nov. 8	13	4
Dec. 7	12	1
1905.		
Jan. 5	11	6
Feb. 7	11	2
Mar. 15	10	3
Apr. 11	10	5½
May 5	10	7½
June 12	11	8
July 14	12	½
Aug. 11	12	6
Sept. 14	13	0
Nov. 6	11	10
Dec. 16	11	3
1906.		
Jan. 25	11	11
Mar. 10	10	3½
May 4	9	6½
June 23	11	3
July 30	9	8½
Sept. 19	10	0
Dec. 18	9	9½

35. Mrs. Mary Pheland, 2 miles SW. of Whittier.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Nov. 9	15	3
1905.		
Jan. 5	14	11½
Feb. 7	14	2½
Mar. 15	13	4
Apr. 10	13	2
May 5	13	4
June 12	13	8½
July 14	14	5
Aug. 11	15	0
Sept. 14	15	8
Nov. 6	14	5
Dec. 16	13	10
1906.		
June 23	12	3
July 30	14	9
Sept. 19	17	10
Dec. 18	12	6½

36. H. C. Baldwin, ½ mile SE. of Whittier.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 8	129	2
Oct. 4	128	4½
Nov. 8	128	5
Dec. 7	128	7½
1905.		
Jan. 5	128	6
Feb. 7	128	7
March 15	128	8
Apr. 11	128	4
May 5	128	3
June 12	128	4½
July 14	128	8
Aug. 11	128	10
Sept. 14	128	11
Nov. 6	129	0
Dec. 16	128	10
1906.		
Jan. 20	128	8
Mar. 10	128	8
May 4	127	5½
June 23	128	6
July 30	128	6
Sept. 19	128	6½
Dec. 18	128	6

37. C. A. Landreth, 1 mile S. of Whittier.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 6	33	5½
Oct. 4	33	7½
Nov. 9	33	5
Dec. 7	33	5½
1905.		
Jan. 5	33	8
Feb. 7	33	3
Mar. 15	32	6
Apr. 11	31	10
May 5	31	8
June 12	31	7
July 14	32	4
Aug. 11	33	2
Sept. 14	33	4
Nov. 6	33	1
Dec. 16	32	10
1906.		
Jan. 25	32	8
Mar. 10	31	8
May 4	31	6½
June 23	31	5½
July 30	33	4
Sept. 19	32	6
Dec. 18	32	½

38. J. W. Sharp, Santa Fe Springs.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 6	27	3½
Oct. 4	26	9½
Nov. 9	27	2
Dec. 7	27	7
1905.		
Jan. 5	27	0
Feb. 7	26	2
Mar. 15	25	7
Apr. 11	25	0
May 5	25	1½
June 12	26	0
July 14	26	8
Aug. 11	27	2
Sept. 14	27	4
Nov. 6	27	3
Dec. 16	26	1
1906.		
Jan. 25	25	4
Mar. 10	24	6
May 4	24	5½
June 23	24	9
July 30	25	8½
Sept. 19	26	9
Dec. 18	25	1

39. John H. Borden, 1½ miles N. of Norwalk.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Nov. 9	7	10
Dec. 7	8	5
1905.		
Jan. 5	7	11
Feb. 7	6	10
Mar. 15	5	10½
Apr. 11	5	4
May 5	5	1
June 12	6	6
July 14	7	2
Aug. 11	8	0
Sept. 14	8	8
Nov. 6	8	7
Dec. 16	7	1
1906.		
Jan. 25	6	7
Mar. 10	6	8
May 4	4	10½
June 23	5	6½
July 30	7	3½
Sept. 19	6	9½
Dec. 18	5	10

Tables showing variations of water level in wells in southern California—Continued.

40. Norwalk Builders' Association, Norwalk.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Sept. 6	19 5
Oct. 4	15 8
Nov. 9	16 4
Dec. 7	17 4
1905.	
Jan. 5	15 3½
Feb. 7	14 1½
Mar. 15	13 4½
May 5	13 7
June 12	14 6
July 14	15 10
Aug. 11	16 11
Sept. 14	17 9
Nov. 6	15 4
Dec. 16	14 7
1906.	
Jan. 25	13 8
Mar. 10	16 11
May 4	16 3
June 23	15 6½
July 30	15 4½
Dec. 18	15 0

41. J. B. Neff, 1½ miles S. of Anaheim.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Aug. 31	50 10
Oct. 1	50 8
Oct. 31	50 8
Dec. 1	50 9
1905.	
Jan. 1	51 0
Feb. 1	50 11
Mar. 1	50 7
Mar. 31	49 10
May 18	49 7
July 1	51 4
July 31	51 7
Aug. 31	52 7
Sept. 30	52 4
Nov. 1	51 10
Dec. 1	51 5
1906.	
Jan. 6	51 4
Mar. 3	51 2
Mar. 31	50 10
Apr. 30	49 5
May 19	49 2
July 1	49 7
July 30	50 6
Sept. 2	51 1
Sept. 27	50 9
Nov. 1	50 2
Nov. 30	49 5

42. Vineland district school. Vineland.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Dec. 14	104 1
1905.	
Jan. 12	104 6
Feb. 21	102 10
Mar. 10	98 9
Apr. 15	93 11
May 17	90 8
June 22	90 11
July 21	91 4
Aug. 16	92 2
Sept. 20	93 9
Nov. 12	95 9
Dec. 21	96 7
1906.	
Jan. 27	97 0
Mar. 15	95 3
May 8	83 4
June 7	81 ½
Aug. 1	82 11
Sept. 25	85 11
Dec. 11	88 10

43. G. F. Chamberlain, 2 miles SW. of Covina.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Oct. 8	119 0
Nov. 17	119 6
Dec. 14	120 9
1905.	
Jan. 12	120 11
Feb. 20	120 9
Mar. 11	120 1
Apr. 15	118 1
May 17	117 9
July 21	112 6
Aug. 16	111 6
Sept. 21	111 6
Nov. 12	112 6
Dec. 21	112 11
1906.	
Mar. 15	113 7
May 9	109 6
June 27	105 3½
Sept. 25	104 4½
Dec. 11	108 1

44. H. Heinze, Puente.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Oct. 8	30 0
Nov. 17	29 10
Dec. 14	30 0
1905.	
Feb. 21	29 2
Mar. 11	28 4
Apr. 15	25 7
June 22	28 6
July 21	27 2
Aug. 16	27 11
Sept. 20	28 3
Dec. 21	28 4½
1906.	
Mar. 15	23 9
May 9	25 6
June 27	23 7½
Sept. 25	26 4½

45. William Rowland, ½ mile S. of Rowland.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Oct. 8	27 0
Nov. 17	26 10
Dec. 14	25 7
1905.	
Jan. 12	24 9
Feb. 21	23 1
Apr. 15	22 8
June 22	23 9
July 21	24 8
Aug. 16	24 10
Sept. 20	26 0
Nov. 12	24 5
Dec. 21	23 5
1906.	
Jan. 27	23 5
May 9	22 11½
June 27	27 7
Aug. 2	25 4
Sept. 25	27 0
Dec. 11	23 8

Tables showing variations of water in wells in southern California—Continued.

46. B. Yorba, 1½ miles E. of Rowland.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 8	35	6
Nov. 17	35	10½
Dec. 14	33	5
1905.		
Jan. 12	30	8
Feb. 20	29	9
Mar. 11	30	10
Apr. 15	31	0
June 22	32	11
July 21	33	2
May 20	33	11
Nov. 12	33	0
Dec. 21	31	5
1906.		
Jan. 27	31	7
Mar. 15	28	2½
May 9	31	6
June 27	30	8
Aug. 2	31	11
Sept. 25	32	11

47. F. Bowers, Lemon.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 8	27	10
Nov. 16	25	4
Dec. 14	25	5½
1905.		
Jan. 12	24	4
Feb. 20	23	10
Mar. 11	23	6
Apr. 15	20	5½
June 22	23	5
July 21	24	0
Aug. 16	25	10
Sept. 20	25	½
Nov. 12	23	4
Dec. 21	22	0
1906.		
Jan. 27	21	6
Mar. 15	21	4
May 9	21	10
June 27	24	8½
Aug. 2	25	8
Sept. 25	25	4½

48. S. E. Hicks, ¼ mile W. of Spadra.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 8	33	8
Nov. 17	32	9
Dec. 14	32	9
1905.		
Jan. 12	32	0
Feb. 21	31	8½
Mar. 11	31	5½
June 22	32	7
July 21	34	2
Aug. 16	35	2
Sept. 20	36	6
Nov. 12	36	2
Dec. 21	35	7
1906.		
Mar. 15	35	5
May 9	34	8
June 27	34	8
Aug. 2	38	7½
Sept. 25	40	2
Dec. 11	39	3

49. Sidney Deacon, 2 miles W. of San Dimas.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 7	124	3
Nov. 16	124	0
Dec. 13	124	0
1905.		
Jan. 11	123	6
Feb. 20	123	5
Mar. 10	127	0
Apr. 14	125	0
May 17	124	8
June 22	125	1½
July 21	125	5
Aug. 16	125	5
Sept. 21	125	7
Nov. 11	126	0
1906.		
Jan. 27	124	6
Mar. 15	124	3
May 8	125	2
June 27	124	6

50. Wm. Ferry, 1¼ miles SW. of San Dimas.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 7	199	8
Nov. 16	199	10
Dec. 13	199	10½
1905.		
Jan. 11	199	9½
Feb. 21	199	8
Mar. 10	199	8½
Apr. 14	200	4
June 22	200	4½
July 23	200	6
Aug. 16	200	7
Sept. 21	200	7
Nov. 11	201	0
Dec. 20	201	0
1906.		
Jan. 27	201	3
Mar. 15	201	3
May 8	201	2
June 26	201	5½
Aug. 2	201	9
Sept. 24	201	7½

51. Azusa Irrigating Co., San Dimas Wash.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 7	97	2
Nov. 16	97	8
Dec. 13	98	11
1905.		
Jan. 11	99	1
Feb. 20	98	4
Mar. 11	97	4
Apr. 14	95	6
May 17	94	3
June 22	94	1
July 20	95	4
Aug. 16	96	4
Sept. 21	97	4
Nov. 11	98	6
Dec. 20	99	0
1906.		
Jan. 27	97	10
Mar. 15	97	2½
May 8	93	2
June 26	91	1½
Aug. 1	92	4
Sept. 24	98	7½
Dec. 10	100	11

Tables showing variations of water in wells in southern California—Continued.

52. Emil Firth, San Dimas Wash.		
Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 7	110	6½
Oct. 7	111	7
Nov. 16	113	2
Dec. 13	113	11
1905.		
Jan. 11	114	8½
Feb. 20	113	11
Mar. 11	113	7
Apr. 14	106	10
May 17	101	9
June 22	104	4
July 20	105	6
Aug. 16	105	10
Sept. 21	106	7½
Nov. 11	108	1½
Dec. 20	108	1
1906.		
Jan. 27	107	6½
Mar. 15	108	2
May 8	87	10
June 26	92	11
Sept. 21	97	4½
Dec. 10	96	11

53. Charles Alley, 1 mile NW. of Lordsburg.		
Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 7	145	4
Nov. 16	146	10
Dec. 13	146	10
1905.		
Jan. 11	146	9
Feb. 20	147	5½
Mar. 10	147	6½
Apr. 14	147	7
June 22	146	8
July 20	150	8
Aug. 16	150	½
Sept. 21	150	11
Nov. 11	152	7
Dec. 20	152	0
1906.		
Jan. 27	151	5½
Mar. 15	149	2½
May 8	149	6
June 26	149	½
Aug. 1	153	1½
Sept. 21	154	4½
Dec. 10	154	7

54. Mr. Massey, ½ mile NE. of Lordsburg.		
Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 7	207	2½
Nov. 16	199	1
Dec. 13	199	3
1905.		
Jan. 11	199	11
Feb. 20	199	10½
Mar. 11	199	9
Apr. 14	200	0
May 17	199	11
June 22	199	4
July 20	200	2
Aug. 16	199	9
Sept. 21	200	0
Nov. 11	202	10
Dec. 20	200	11
1906.		
Jan. 27	201	1
Mar. 15	200	2
May 8	198	4½
June 26	197	6
Aug. 1	196	5½
Sept. 24	196	7½
Dec. 10	197	3½

55. Ontario Water Co., 1 mile N. of Claremont.		
Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Nov. 16	62	1
Dec. 13	61	10
1905.		
Jan. 11	62	2
Feb. 20	62	1
Mar. 10	61	10½
Apr. 14	59	4
May 17	59	1½
June 22	57	5
July 20	57	0
Aug. 16	59	7
Sept. 21	58	6
Nov. 11	58	4½
Dec. 20	57	3
1906.		
Jan. 26	56	9½
Mar. 14	53	½
May 8	51	1
June 26	53	[illegible]
Aug. 1	51	[illegible]
Sept. 21	53	[illegible]
Dec. 10	46	11

56. R. Bieley, Claremont.		
Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 8	97	4
Nov. 16	97	6
Dec. 13	98	1½
1905.		
Jan. 11	97	0
Feb. 20	92	5
Mar. 10	91	2
Apr. 11	89	9
May 17	88	10
June 22	92	0
July 20	97	4
Aug. 16	98	7
Sept. 21	99	9
Dec. 20	93	8
1906.		
Jan. 27	97	9½
Mar. 11	84	10
May 8	82	1
June 26	81	2
Aug. 1	76	3
Sept. 21	65	5
Dec. 10	49	9

57. San Antonio Water Co., ½ mile SW. of Claremont.		
Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 6	158	5
Nov. 16	156	2
Dec. 13	155	0
1905.		
Jan. 11	153	1½
Feb. 20	151	1
Mar. 10	150	2
Apr. 14	148	7
May 17	147	1
June 22	148	7
July 20	150	10
Aug. 16	150	8
Sept. 21	152	6½
Nov. 11	152	1
Dec. 20	149	1
1906.		
Jan. 26	149	6
Mar. 14	144	3
May 8	141	2
Aug. 1	146	8
Sept. 24	149	8½
Dec. 10	149	8

Tables showing variations of water in wells in southern California—Continued.

58. Dr. A. R. Reed, 1½ miles NE. of Pomona.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 7	75	2
Oct. 6	75	4½
Nov. 16	74	6
Dec. 13	74	3
1905.		
Jan. 11	68	10½
Feb. 20	66	1
Mar. 10	65	11
Apr. 14	63	11
May 17	62	11
June 22	66	8
July 20	70	10
Aug. 16	71	11
Sept. 21	73	5
Nov. 11	70	4½
Dec. 20	67	0
1906.		
Jan. 26	64	9
Mar. 14	62	10
May 8	62	5
June 26	64	5
Aug. 1	67	0
Sept. 24	67	½
Dec. 10	64	3½

59. B. Linastruth, Pomona.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Dec. 14	90	6½
1905.		
Jan. 12	90	0
Feb. 21	91	1
Apr. 15	91	5
May 17	91	6½
June 22	92	0
July 21	92	10½
Sept. 20	93	6
Nov. 12	93	4
Dec. 21	93	6
1906.		
Mar. 15	92	6
June 27	93	6
Aug. 2	95	6
Sept. 25	96	0
Dec. 11	95	2

60. J. J. White, Pomona.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 6	58	9½
Nov. 16	60	3
Dec. 13	60	6½
1905.		
Jan. 11	60	10
Feb. 20	61	1½
Mar. 10	61	4½
Apr. 14	60	8
May 17	60	11
June 22	61	1
Aug. 16	61	6
Sept. 20	61	10
Nov. 11	62	4
Dec. 20	62	5
1906.		
Jan. 26	62	3½
Mar. 14	63	1
May 8	63	1½
Aug. 1	63	5
Sept. 24	64	4½
Dec. 10	64	11

61. Mrs. Tieg, 1½ miles SE. of Pomona.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 8	89	0
Oct. 6	88	10
Nov. 16	88	10½
Dec. 13	88	10
1905.		
Jan. 11	88	10
Feb. 20	89	0
Mar. 10	89	0
Apr. 14	88	0
June 22	88	11
July 20	90	1½
Aug. 16	90	5
Sept. 20	90	8½
Nov. 11	90	5
Dec. 20	90	6
1906.		
Jan. 26	89	6
Mar. 14	90	6
May 8	89	7
Aug. 1	92	2
Sept. 24	92	2

62. R. Riemers, 2½ miles SE. of Pomona.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 8	34	6
Oct. 6	36	6½
Nov. 16	34	10
Dec. 13	34	10
1905.		
Jan. 11	34	9½
Feb. 20	34	7½
Apr. 14	32	10
May 17	32	7
June 22	33	6
July 20	35	4
Aug. 16	35	0
Sept. 20	35	6
Nov. 11	35	8
Dec. 20	35	7½
1906.		
Jan. 26	36	8½
Mar. 14	35	8
May 8	33	2½
June 26	34	4½
Aug. 1	35	5
Sept. 24	36	2½
Dec. 10	36	2½

63. C. P. Brown, 2½ miles SE. of Pomona.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Sept. 7	8	9
Oct. 6	6	6½
Nov. 16	3	10
Dec. 13	3	3
1905.		
Jan. 11	2	5
Feb. 20	2	0
Mar. 10	2	½
Apr. 14	1	5
May 17	2	0
June 22	7	5
July 20	12	10
Aug. 16	12	2
Sept. 20	11	10½
Nov. 11	4	7½
Dec. 20	4	1
1906.		
Jan. 26	4	3½
Mar. 14	3	10
May 8	4	4½
June 26	13	10
Aug. 1	15	8
Sept. 24	13	6
Dec. 10	4	10

Tables showing variations of water in wells in southern California—Continued.

64. Mr. Haley, ½ mile W. of San Bernardino.

Date of measurement.	Depth to water.
1904.	*Ft.*
July 5	36.6
Aug. 4	38.18
Sept. 1	37.23
Oct. 3	37.10
Nov. 1	38.9
Dec. 1	39.83
1905.	
Jan. 1	37.15
Feb. 1	33.0
Mar. 1	30.55
Apr. 1	29.78
May 1	30.1
June 1	37.6
July 1	39.0
Oct. 1	40.5
Nov. 1	36.8
Dec. 1	33.7
1906.	
Jan. 1	33.7
Feb. 1	33.0
Mar. 1	32.0
Apr. 1	31.38
May 1	36.57
June 1	35.7
July 1	38.4
Oct. 22	30.4

65. C. W. Rogers, 1 mile E. of Colton.

Date of measurement.	Depth to water.
1904.	*Ft.*
July 1	15.7
Aug. 4	18.05
Sept. 1	19.70
Oct. 3	20.96
Nov. 1	20.17
Dec. 1	21.82
1905.	
Jan. 1	17.48
Feb. 1	12.45
Mar. 1	7.57
Apr. 1	5.4
May 1	5.6
June 1	6.4
July 1	9.3
Aug. 1	12.75
Sept. 1	15.9
Oct. 1	18.45
Nov. 1	18.28
1906.	
Jan. 1	14.34
Feb. 1	12.58
Mar. 1	8.35
Apr. 1	5.40
May 1	6.00
June 1	5.9
July 1	6.85
Oct. 22	17.2

66. Riverside Water Co., 2 miles E. of Colton.

Date of measurement.	Yield in miner's inches.
1904.	
Aug. 1	3.69
Sept. 1	4.4
Oct. 3	5.16
Nov. 1	4.4
Dec. 1	5.16
1905.	
Jan. 1	5.16
Feb. 1	Capped.
Mar. 1	Capped.
Apr. 1	Capped.
May 1	5.16
June 1	5.16
July 1	7.5
Aug. 1	5.16
Sept. 1	3.7
Oct. 1	4.12
Nov. 1	4.32
Dec. 1	Capped.
1906.	
Jan. 1	Capped.
Feb. 1	Capped.
Mar. 1	Capped.
Apr. 1	Capped.
May 1	Capped
June 1	Capped.
July 1	Capped.
Oct. 22	4.55

67. Riverside Water Co., Third and Waterman sts., San Bernardino.

Date of measurement.	Yield in miner's inches.
1904.	
Aug. 1	121.5
Sept. 1	121.6
Oct. 3	112.5
Nov. 1	116.0
Dec. 1	116.3
1905.	
Jan. 1	117.0
Feb. 1	Capped.
Mar. 1	Capped.
Apr. 1	Capped.
May 1	Capped.
June 1	117.0
July 1	118.4
Aug. 1	116.7
Sept. 1	111.6
Oct. 1	115.1
Nov. 1	Capped.
Dec. 1	Capped
1906.	
Jan. 1	Capped.
Feb. 1	Capped.
Mar. 1	Capped.
Apr. 1	Capped.
May 1	Capped.
June 1	Capped.
July 1	149.5
Oct. 22	104.9

68. N. B. Hinkley estate, ¾ mile W. of Bryn Mawr.

Date of measurement.	Depth to water.
1904.	*Ft.*
July 1	85.9
Aug. 4	82.7
Sept. 1	84.5
Oct. 3	80.0
Nov. 1	80.6
Dec. 1	80.8
1905.	
Jan. 1	81.0
Feb. 1	80.8
Mar. 1	80.7
Apr. 1	79.0
May 1	78.5
June 1	78.0
July 1	78.4
Aug. 1	78.7
Sept. 1	79.2
Oct. 1	79.35
Nov. 1	81.0
Dec. 1	79.5
1906.	
Jan. 1	79.4
Feb. 1	78.5
Mar. 1	77.89
Apr. 1	77.27
May 1	74.66
June 1	74.4
July 1	74.2
Oct. 22	75.7

69. Riverside County, 2½ miles S. of Alessandro.

Date of measurement.	Depth to water.	
1904.	*Ft.*	*in.*
Oct. 18	52	4½
Nov. 18	51	10
Dec. 15	51	7½
1905.		
Jan. 13	51	8½
Feb. 22	50	5
Mar. 24	49	6
Apr. 19	49	2
May 19	49	1
July 22	50	4
Aug. 18	50	8
Sept. 22	50	11
Nov. 9	51	½
1906.		
May 11	51	9½
June 29	52	4
Aug. 3	52	9
Sept. 26	52	8

Tables showing variations of water in wells in southern California—Continued.

70. 4 miles NE. of Perris.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Dec. 16	32	5
1905.		
Jan. 14	32	0
Feb. 22	31	6
Sept. 22	28	5
Nov. 9	29	0
Dec. 23	29	4
1906.		
Jan. 30	29	4
Mar. 16	29	3
May 11	29	7½
Aug. 3	29	11½
Sept. 26	30	½
Dec. 20	30	2½

71. C. Lossman, 2½ miles N. of Perris.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Dec. 15	63	3½
1905.		
Jan. 13	63	4½
Feb. 22	63	0
Mar. 26	62	6
Apr. 19	62	3½
May 19	62	0
June 20	62	0
July 22	62	2
Aug. 19	62	2
Sept. 22	62	3
Nov. 9	62	5
Dec. 23	62	5
1906.		
Mar. 16	62	4
May 11	62	5
June 29	62	5
Aug. 3	63	2
Sept. 26	63	4
Dec. 20	63	4½

72. Crawford Carter, Perris.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Oct. 18	33	4
Nov. 18	33	3
Dec. 15	33	4
1905.		
Jan. 13	32	6
Feb. 22	31	9½
Mar. 26	30	10
Apr. 18	30	7
May 19	30	2½
June 20	30	1
July 23	30	4
Sept. 22	30	6
Nov. 9	30	11
Dec. 22	31	4½
1906.		
Jan. 29	31	8
Mar. 16	31	8
June 28	31	2½
Aug. 3	31	9
Sept. 26	32	4½
Dec. 20	32	3

73. Mrs. L. R. Harford, 3½ miles E. of Perris.

Date of measurement.	Depth to water.	
1901.	Ft.	in.
May	28	11
1902.		
July	40	2
Oct. 25	41	7
Dec. 15	42	9
1903.		
Feb. 28	38	7
Apr. 11	37	6
May 14	38	2
Sept. 15	43	4
1904.		
Jan. 31	43	4
Feb. 28	41	11½
Mar. 3	41	9
Mar. 29	40	11
May 1	42	10
July 3	44	10
Sept. 15	45	5
1905.		
Sept. 23	44	9
Dec. 22	43	0
1906.		
Jan. 29	42	3
Mar. 16	42	2
May 12	40	2½
June 28	38	8½
Aug. 4	41	7
Sept. 27	42	5½
Dec. 21	43	6½

74. E. E. Waters, Ethanac.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Jan 29	44	2
Feb. 27	41	4
Mar. 27	40	5½
Mar. 27	43	4
May 27	41	7½
July 2	46	0
1905.		
Feb. 20	44	8
Apr. 5	43	1½
June 18	45	5½
Aug. 5	46	11
Sept. 1	47	6
Oct. 1	47	10
Nov. 6	48	2
Dec. 22	44	8
1906.		
Jan. 29	42	10
Feb. 4	42	4
Mar. 16	42	8
May 12	41	2
June 28	44	10½
Aug. 4	45	0
Sept. 27	47	6½
Dec. 21	45	3

75. Temescal Water Co., 1½ miles W. of Ethanac.

Date of measurement.	Depth to water.	
1904.	Ft.	in.
Oct. 18	29	10
Nov. 18	30	4
Dec. 15	30	7
1905.		
Jan. 13	30	3½
Feb. 22	26	10½
Mar. 26	25	10
June 20	28	0
July 23	28	9
Aug. 19	29	5
Sept. 23	29	8
Nov. 10	30	3
Dec. 22	29	8
1906.		
Jan. 29	29	7½
Mar. 16	28	8½
May 12	27	9
June 28	27	9
Aug. 4	28	7
Sept. 27	30	1
Dec. 21	30	2

Tables showing variations of water in wells in southern California—Continued.

76. Doctor Reese, 2½ miles S. of Perris.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Oct. 18	21	10
Nov. 18	19	0
Dec. 15	18	9½
1905.		
Jan. 13	18	5
Feb. 22	10	9
Mar. 26	9	7½
May 19	11	11
June 20	13	4
July 23	13	3
Aug. 19	13	4
Sept. 23	15	6
Nov. 10	15	8
Dec. 22	15	10½
1906.		
Jan. 29	15	9
Mar. 16	15	7
May 12	15	2
June 28	15	5
Sept. 27	16	2½

77. William Newport, 4½ miles S. of Perris.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Oct. 18	37	3
Nov. 18	37	10
Dec. 15	38	3
1905.		
Jan. 13	38	8
Feb. 22	38	0
Mar. 26	37	½
Apr. 18	36	7
May 19	36	1½
June 20	36	8½
July 23	37	9
Aug. 19	38	2
Sept. 23	38	7½
Nov. 10	39	5
Dec. 22	39	4
1906.		
Jan. 29	38	6
Mar. 16	38	5½
May 12	37	4½
June 28	36	3
Aug 4	37	0
Sept. 27	38	0
Dec. 21	38	5½

78. William Newport, Menifee Valley.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Oct. 18	28	2
Nov. 18	28	3½
Dec. 15	27	7
1905.		
Jan. 13	27	3½
Feb. 22	24	½
Mar. 26	21	7½
Apr. 18	21	9
May 19	21	6
June 20	21	9
July 23	22	6
Aug. 19	22	2
Sept. 23	21	7
Nov. 9	21	11
Dec. 22	22	11
1906.		
Jan. 29	22	11
Mar. 16	21	9
May 12	19	10½
June 28	19	10½
Aug. 4	21	0
Sept. 27	21	7
Dec. 21	21	10

79. H. H. Lindenberger, 4 miles SW. of Winchester.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1905.		
Feb. 22	23	4
Mar. 25	22	5
Apr. 18	20	3
May 19	19	0
July 23	19	0
Sept. 23	18	7
Nov. 10	18	6
Dec. 22	18	3½
1906.		
Jan. 29	18	0
Mar. 16	18	3
May 12	16	9
June 28	16	9
Sept. 27	16	11½
Dec. 21	16	10

80. M. M. Patterson, Winchester.

Date of measurement.	Depth to water.	
	Ft.	*in.*
1904.		
Oct. 18	24	3
Nov. 18	23	5
Dec. 15	22	6
1905.		
Jan. 13	22	3½
Feb. 22	21	5
Apr. 18	20	2
May 19	20	2
July 23	19	7
Aug. 19	19	8
Sept. 23	19	10
Nov. 9	20	1
Dec. 22	20	4
1906.		
Jan. 29	19	3
May 12	20	0
Aug. 4	19	11½
Sept. 27	20	1
Dec. 21	20	2½

81. Mrs. Maud F. Walker, 3 miles SW. of Hemet

Date of measurement.	Depth to water.	
	Ft.	*in.*
1905.		
Mar. 25	14	6
Apr. 18	10	6
May 19	10	10
June 20	10	6
July 23	10	6
Aug. 19	10	7½
Sept. 23	11	1
Nov. 10	10	11
Dec. 22	11	2½
1906.		
Jan. 30	10	8
Mar. 16	10	7
May 12	10	4
June 28	9	7
Aug. 4	10	4
Sept. 27	10	7
Dec. 21	10	7

Tables showing variations of water in wells in southern California—Continued.

82. J. E. Garrigan, 1 mile W. of Hemet.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Dec. 15	33 3
1905.	
Jan. 14	33 5
Feb. 23	33 3
Mar. 25	33 1½
Apr. 18	33 1
May 18	33 0
June 20	33 2
July 23	33 1
Aug. 19	34 0
Sept. 23	33 6
Nov. 10	33 0
1906.	
Jan. 30	32 9
Mar. 17	32 5
May 12	32 10½
June 29	32 6
Aug. 4	32 9
Sept. 27	32 7½
Dec. 20	32 6½

83. Mrs. Ruby Hewitt, ½ mile E. of Bowers.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Oct. 19	11 5
Nov. 19	11 9
Dec. 16	12 2
1905.	
Jan. 14	12 4
Feb. 23	10 1
Mar. 26	5 5
Apr. 19	2 1
May 19	([a])
June 20	([a])
July 22	0 7
Aug. 18	1 8
Sept. 22	3 2
Nov. 10	4 7½
Dec. 22	5 7½
1906.	
Jan. 30	6 5
Mar. 17	5 6
May 11	([b])
June 29	Flowing.
Aug. 3	([c])
Sept. 26	Flowing.

84. J. Carmichael, Bowers.

Date of measurement.	Depth to water.
1904.	*Ft. in.*
Oct. 19	7 7½
Nov. 19	7 10½
Dec. 16	8 0
1905.	
Jan. 14	8 1
Feb. 22	6 8
Mar. 26	4 3
Apr. 18	2 4
May 19	Flowing.
June 21	Flowing.
July 22	Flowing.
Aug. 18	3 9
Sept. 22	2 6
Nov. 10	2 9
Dec. 22	3 1
1906.	
Jan. 30	2 9
Mar. 17	2 8
May 11	Flowing.
Aug. 3	Flowing.
Sept. 26	Flowing.
Dec. 20	Flowing.

85. K. D. Harger, Lakeview.

Date of measurement.	Depth to water.	Date of measurement.	Depth to water.	Date of measurement.	Depth to water.
1904.	*Ft. in.*	1905.	*Ft. in.*	1906.	*Ft. in.*
Nov. 19	30 1	May 19	28 11	Jan. 30	29 6
Dec. 16	29 10	June 21	28 10	May 11	29 2
		July 22	28 11	June 29	29 2
1905.		Aug. 18	29 1	Aug. 3	29 3½
Feb. 22	29 5	Sept. 22	29 3	Sept. 26	29 5½
Mar. 26	29 2½	Nov. 9	29 5	Dec. 20	29 8
Apr. 19	29 0	Dec. 23	29 7		

[a] Flowing good stream.

[b] Flowing 5 miner's inches.

[c] Flowing 7 miner's inches.

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CLASSIFICATION OF THE PUBLICATIONS OF THE UNITED STATES GEOLOGICAL SURVEY.

[Water-Supply Paper No. 213.]

The publications of the United States Geological Survey consist of (1) Annual Reports; (2) Monographs; (3) Professional Papers; (4) Bulletins; (5) Mineral Resources; (6) Water-Supply and Irrigation Papers; (7) Topographic Atlas of United States, folios and separate sheets thereof; (8) Geologic Atlas of United States, folios thereof. The classes numbered 2, 7, and 8 are sold at cost of publication; the others are distributed free. A circular giving complete lists can be had on application.

Most of the above publications can be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they can be obtained, free of charge (except classes 2, 7, and 8), on application.
2. A certain number are delivered to Senators and Representatives in Congress for distribution.
3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they can be had at practically cost.
4. Copies of all Government publications are furnished to the principal public libraries in the large cities throughout the United States, where they can be consulted by those interested.

The Professional Papers, Bulletins, and Water-Supply Papers treat of a variety of subjects, and the total number issued is large. They have therefore been classified into the following series: A, Economic geology; B, Descriptive geology; C, Systematic geology and paleontology; D, Petrography and mineralogy; E, Chemistry and physics; F, Geography; G, Miscellaneous; H, Forestry; I, Irrigation; J, Water storage; K, Pumping water; L, Quality of water; M, General hydrographic investigations; N, Water power; O, Underground waters; P, Hydrographic progress reports; Q, Fuels; R, Structural materials.

Series P.—The hydrographic progress reports contain the results of stream measurements. A report is issued for every calendar year, containing the results of data collected during that year. These reports were first published as a part of the Director's annual report or as a bulletin; they are now published as water-supply and irrigation papers. The following is a list, by years, of the publications containing the progress reports of stream measurements (* means out of stock). A detailed index of these reports (1888-1903) is published as Water-Supply Paper No. 119.

1888. Tenth Annual Report, Part II*.
1889. Eleventh Annual Report, Part II*
1890. Twelfth Annual Report, Part II*.
1891. Thirteenth Annual Report, Part III*.
1892. Fourteenth Annual Report, Part II*.
1893. Bulletin No. 131*.
1894. Bulletin No. 131*; Sixteenth Annual Report, Part II*.
1895. Bulletin No. 140*.
1896. Water-Supply Paper No. 11*, Eighteenth Annual Report, Part IV*.
1897. Water-Supply Papers Nos. 15* and 16*, Nineteenth Annual Report, Part IV*.
1898. Water-Supply Papers Nos. 27* and 28*. Twentieth Annual Report, Part IV*.
1899. Water-Supply Papers Nos. 35*, 36*, 37*, 38*, and 39*, Twenty-first Annual Report, Part IV*.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65* and 75*.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75*.

1902. East of Mississippi River, Water-Supply Papers Nos. 82 and 83.
West of Mississippi River, Water-Supply Papers Nos. 84 and 85.
1903. East of Mississippi River, Water-Supply Papers Nos. 97 and 98.
West of Mississippi River, Water-Supply Papers Nos. 99 and 100.
1904. East of Mississippi River, Water-Supply Papers Nos. 124, 125, 126, 127, 128, and 129.
West of Mississippi River, Water-Supply Papers Nos. 130, 131, 132, 133, 134, and 135.
1905. East of Mississippi River, Water-Supply Papers Nos. 165*, 166*, 167, 168*, 169, 170, and 171.
West of Mississippi River, Water-Supply Papers Nos. 171, 172*, 173*, 174, 175*, 176, 177, and 178.
1906. East of Mississippi River, Water-Supply Papers Nos. 201, 202, 203, 204, 205, 206, and 207.
West of Mississippi River, Water-Supply Papers Nos. 207, 208, 209, 210, 211, 212, 213, and 214.

Correspondence should be addressed to

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WASHINGTON, D. C.

OCTOBER, 1907.

Water-Supply and Irrigation Paper No. 214 Series P, Hydrographic Progress Reports, 68

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

SURFACE WATER SUPPLY
OF
THE NORTH PACIFIC COAST DRAINAGE, 1906

J. C. STEVENS, ROBERT FOLLANSBEE, and E. C. LA RUE
DISTRICT HYDROGRAPHERS

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SURFACE WATER SUPPLY OF THE NORTH PACIFIC COAST DRAINAGE, 1906.[a]

J. C. Stevens, Robert Follansbee, and E. C. La Rue,
District Hydrographers.[b]

INTRODUCTION.

SCOPE OF WORK.

The water supply of the United States is of more importance to the life and pursuits of the people than is any other natural resource. In the arid States the limit of agricultural development is determined by the amount of water available for irrigation, while in all parts of the country the increase in the population of cities and towns makes necessary additional water supplies for domestic and industrial uses, in procuring which both the quantity and the quality of the water that may be obtained must be considered. The location of manufacturing plants may depend largely on the water-power facilities and on the character of the water. The notable advances made in the electric transmission of power have led to the utilization of water powers for the operation of manufacturing establishments, railroads, and municipal lighting plants, many of which are at some distance from the places at which the power is developed.

The intelligent establishment and maintenance of enterprises or industries that depend on the use of water demands a thorough knowledge of the flow of the streams and an understanding of the conditions affecting that flow. This knowledge should be based on data showing both the total flow and the distribution of the flow throughout the year, in order that normal fluctuations may be provided for. As the flow of a stream is variable from year to year estimates of future flow can be made only from a study of observations covering several years. The rapid increase in the development of the water resources of the United States has caused a great demand by engineers for information in regard to the flow of streams, as it is now generally realized that the failure of many large power, irrigation, and other projects has been due to the fact that the plans were made without sufficient trustworthy information in respect to the water supply.

---

[a] The report contains information similar to that published in previous years under the title "Report of Progress of Stream Measurements."

[b] The data presented in this paper have been collected as follows:

Columbia River drainage in Oregon and Washington, and Puget Sound and Pacific Coast drainages north of the Oregon-California State line, by J. C. Stevens, district hydrographer, assisted by R. M. Hall, Ivan Landes, W. C. Muldrow, and H. D. McGlashan; in cooperation in Oregon with John H. Lewis, State engineer, assisted by L. R. Allen, Ivan E. Oakes, and Percy A. Cupper.

Clark Fork drainage by Robert Follansbee, district hydrographer.

Snake River drainage in Idaho and Wyoming by E. C. La Rue, district hydrographer.

The data have been prepared for publication under the direction of John C. Hoyt by R. H. Bolster, Robert Follansbee, F. F. Henshaw, J. E. Stewart, and H. D. Padgett.

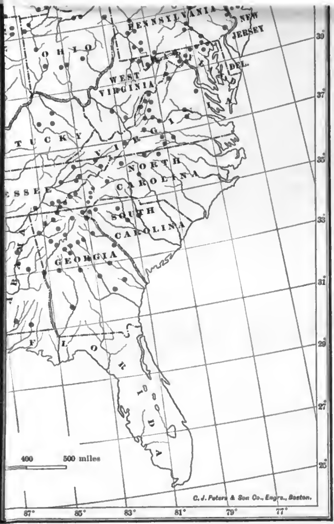
Owing to the broad scope of these hydrographic investigations and the length of time they should cover in order that the records may be of greatest value, it is, in general, impossible for private individuals to collect the necessary data, and as many of the streams traverse more than one State this work does not properly fall within the province of the State authorities. The United States Geological Survey has therefore, by means of specific appropriations by Congress, for several years systematically made records of stream flow, with the view of ultimately determining all the important features governing the flow of the principal streams of the country. In carrying out this plan stations are established on the streams and maintained for a period long enough to show their regimen or general behavior. When a record that is sufficient for this purpose has been obtained for any stream the work on that stream is discontinued. The order in which the streams are measured is determined by the degree of their importance.

During 1906 the regimen of flow was studied at about 700 stations distributed along the various rivers throughout the United States, as shown on Pl. I. In addition to these records data in regard to precipitation, evaporation, water power, and river profiles were obtained in many sections of the country.

These data have been assembled by drainage areas, and are published in a series of fourteen Water-Supply and Irrigation Papers, Nos. 201 to 214, inclusive, each of which pertains to the surface water resources of a group of adjacent areas. In these papers are embodied not only the data collected in the field, but also the results of computations based on these data, and other information that has a direct bearing on the subject, such as descriptions of basins and the streams draining them, utility of the water resources, etc. The list follows:

Water-Supply and Irrigation Papers on surface water supply, 1906.

201. Surface water supply of New England, 1906. (Atlantic coast of New England drainage.)
202. Surface water supply of the Hudson, Passaic, Raritan, and Delaware river drainages, 1906.
203. Surface water supply of the Middle Atlantic States, 1906. (Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages.)


PENNSYLVANIA
NEW JERSEY
DEL.
OHIO
WEST VIRGINIA
TUCKY
VIRGINIA
NORTH CAROLINA
SSEE
SOUTH CAROLINA
GEORGIA
FLORIDA
400
500 miles
C. J. Peters & Son Co., Engrs., Boston.
39°
37°
35°
33°
31°
29°
27°
25°
87°
85°
83°
81°
79°
77°

NG 1906.

204. Surface water supply of the Southern Atlantic and Eastern Gulf States, 1906. (Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages.)
205. Surface water supply of the Ohio and lower eastern Mississippi river drainages, 1906.
206. Surface water supply of the Great Lakes and St. Lawrence River drainages, 1906.
207. Surface water supply of Hudson Bay and upper Mississippi River drainages, 1906.
208. Surface water supply of the Missouri River drainage, 1906.
209. Surface water supply of the lower western Mississippi River drainage, 1906.
210. Surface water supply of the western Gulf of Mexico and Rio Grande drainages, 1906.
211. Surface water supply of the Colorado River drainage above Yuma, 1906.
212. Surface water supply of the Great Basin drainage, 1906.
213. Surface water supply of California, 1906. (The Great Basin and Pacific Ocean drainage in California, and Colorado River drainage below Yuma.)
214. Surface water supply of the North Pacific Coast drainage, 1906.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing such records up to and including 1903 has been published in Water-Supply Paper No. 119. The following table gives, by years and primary drainage basins, the numbers of the papers on the surface water supply, published from 1901 to 1906.

Number of Water-Supply Papers containing results of stream measurements, 1901–1906.[a]

	1901.	1902.	1903.	1904.	1905.	1906.
Atlantic coast of New England drainage	65 75	82	97	124	165	201
Hudson, Passaic, Raritan, and Delaware river drainages	65 75	82	97	125	166	202
Susquehanna, Gunpowder, Patapsco, Potomac, James, Roanoke, and Yadkin river drainages	65 75	82 83	97 98	126	167	203
Santee, Savannah, Ogeechee, and Altamaha rivers, and eastern Gulf of Mexico drainages	65 75	83	98	127	168	204
Ohio and lower eastern Mississippi river drainages	65 75	83	98	128	169	205
Great Lakes and St. Lawrence River drainages	65	83	97	129	170	206
Hudson Bay and upper eastern and western Mississippi River drainages	65 66 75	83 84 85	98 99 100	128 130	171	207
Missouri River drainage	66 75	84	99	130 131	172	208
Meramec, Arkansas, Red, and lower western Mississippi river drainages	66 75	84	99	131	173	209
Western Gulf of Mexico and Rio Grande drainages	66 75	84	99	132	174	210
Colorado River drainage above Yuma	66 75	85	100	133	175	211
The Great Basin drainage	66 75	85	100	133	176	212
The Great Basin and Pacific Ocean drainages in California, and Colorado River drainage below Yuma	66 75	85	100	134	177	213
North Pacific Coast drainage	66 75	85	100	135	178	214

[a] Reports containing data for years prior to 1901 are noted in the series list at the end of this paper.

DEFINITIONS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile; and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the quantity of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which others are computed.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the quantity of water that passes through an orifice 1 inch square under a head which varies locally. It has been commonly used by miners and irrigators throughout the West, and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly, both as regards time and area.

"Run-off in inches" is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work. There is a convenient relation between the second-foot and the acre-foot: One second-foot flowing for twenty-four hours will deliver 86,400 cubic feet, or approximately 2 acre-feet.

EXPLANATION AND USE OF TABLES.

For each regular gaging station are given, as far as available, the following data:

1. Description of station.
2. List of discharge measurements.
3. Gage-height table.
4. Rating table.
5. Table of monthly and yearly discharges and run-off.
6. Tables showing discharge and horsepower and the number of days during the year when the same are available.

The descriptions of stations give such general information about the locality and equipment as would enable the reader to find and use the station, and they also give, as far as possible, a complete history of all the changes that have occurred since the establishment of the station that would be factors in using the data collected.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, the name of the hydrographer, the width and area of cross section, the gage height, and the discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage heights taken each day. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. At most stations the gage is read in the morning and in the evening.

The discharge measurements and gage heights are the base data from which the other tables are computed. In cases of extensive development it is expected that engineers will use these original data in making their calculations, as the computations made by the Survey are based on the data available at the time they are made and should be reviewed, and, if necessary, revised when additional data are available.

The rating table gives the discharge in second-feet corresponding to various stages of the river as given by the gage heights. It is published to enable engineers to determine the daily discharge, in case this information is desired.

In the table of monthly discharge, the column headed "Maximum" gives the mean flow for the day when the mean gage height was highest, and it is the flow as given in the rating table for that mean gage height. As the gage height is the mean for the day, there might have been short periods when the water was higher and the corresponding discharge larger than given in this column. Likewise, in the column of "Minimum," the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow for each second during the month. Upon this the computations for the remaining columns, which are defined on page 4, are based.

The values in the table of monthly discharge are intended to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates.

In most work where data in regard to flow are used the regimen of flow is of primary importance. Therefore, for the principal stations, tables have been prepared showing the horsepower that can be developed at various rates of flow, and the length of time that these rates of flow and the corresponding horsepower are available.

These tables have been prepared on a basis of 80 per cent efficiency on the turbines, and the horsepower per foot of fall is given in order that the reader can determine the horsepower for any fall.

In the computations, sufficient significant figures have been used so that the percentage of error in the tables will not in general exceed 1 per cent. Therefore, most of the values in the tables are given to only three significant figures. In making the various computations Thatcher's slide rule, Crelle's tables, and computation machines have been generally used.

In order to give engineers an idea of the relative value of the various data, notes in regard to accuracy are given as far as possible. This accuracy depends on the general local conditions at the gaging stations and the amount of data collected. Every effort possible is made to so locate the stations that the data collected will give a high degree of accuracy. This is not always possible but it is considered better to publish rough values with explanatory notes rather than no data.

In the accuracy notes the following terms have been used indicating the probable accuracy, in per cent, of the mean monthly flow. As these values are mean values, the error in the value for the flow of any individual day may be much larger.

Excellent indicates that the mean monthly flow is probably accurate to within 5 per cent; good, to within 10 per cent; fair, to within 15 per cent; approximate, to within 25 per cent.

CONVENIENT EQUIVALENTS.

Following is a table of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).

1 second-foot equals 38.4 Colorado miner's inches.

1 second-foot equals 40 Arizona miner's inches.

1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.

1 second-foot equals 6.23 British imperial gallons per second.

1 second-foot for one year covers 1 square mile 1.131 feet deep, 13.572 inches deep.

1 second-foot for one year equals 31,536,000 cubic feet.

1 second-foot equals about 1 acre-inch per hour.

1 second-foot for one day covers 1 square mile 0.03719 inch deep.

1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.

1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.

1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.

1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.

1 second-foot for one day equals 1.983 acre-feet.

1 second-foot for one 28-day month equals 55.54 acre-feet.

1 second-foot for one 29-day month equals 57.52 acre-feet.

1 second-foot for one 30-day month equals 59.50 acre-feet.

1 second-foot for one 31-day month equals 61.49 acre-feet.

100 California miner's inches equal 18.7 United States gallons per second.
100 California miner's inches equal 96.0 Colorado miner's inches.
100 California miner's inches for one day equal 4.96 acre-feet.
100 Colorado miner's inches equal 2.60 second-feet.
100 Colorado miner's inches equal 19.5 United States gallons per second.
100 Colorado miner's inches equal 104 California miner's inches.
100 Colorado miner's inches for one day equal 5.17 acre-feet.
100 United States gallons per minute equal 0.223 second-foot.
100 United States gallons per minute for one day equal 0.442 acre-foot.
1,000,000 United States gallons per day equal 1.55 second-feet.
1,000,000 United States gallons equal 3.07 acre-feet.
1,000,000 cubic feet equal 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5.280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.
1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
1⅓ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel, realizing 80 per cent of theoretical power.

FIELD METHODS OF MEASURING STREAM FLOW.

The methods used in collecting these data and in preparing them for publication are given in detail in Water-Supply Papers No. 94 (Hydrographic Manual, U. S. Geol. Survey) and No. 95 (Accuracy of Stream Measurements). In order that those who use this report may readily become acquainted with the general methods employed, the following brief descriptions are given:

Streams may be divided, with respect to their physical conditions, into three classes—(1) those with permanent beds; (2) those with beds which change only during extreme low or high water; (3) those with constantly shifting beds. In determining the daily flow special methods are necessary for each class. The data on which the determinations are based and the methods of collecting them are, however, in general the same.

There are three distinct methods of determining the flow of open-channel streams—(1) by measurements of slope and cross section and the use of Chezy's and Kutter's formulas; (2) by means of a weir; (3) by measurements of the velocity of the current and the area of the cross section. The method chosen for any case depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{R\,s}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in determining the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions.

Weir methods.—When funds are available and the conditions are such that sharp-crested weirs can be erected, these offer the best facilities for determining flow. If dams are suitably situated and constructed they may be utilized for obtaining reliable measurements of flow. The conditions necessary to insure good results may be divided into two classes—(1) those relating to the physical characteristics of the dam itself, and (2) those relating to the diversion and use of water around and through the dam.

The physical requirements are as follows: (*a*) Sufficient height of dam, so that backwater will not interfere with free fall over it; (*b*) absence of leaks of appreciable magnitude; (*c*) topography or abutments which confine the flow over the dam at high stages; (*d*) level crests, which are kept free from obstructions caused by floating logs or ice; (*e*) crests of a type for which the coefficients to be used in $Q=c\,b\,h^{\frac{3}{2}}$, or some similar standard weir formula, are known (see Water-Supply Papers Nos. 180 and 200[a]); (*f*) either no flashboards or exceptional care in reducing leakage through them and in recording their condition.

Preferably there should be no diversion of water through or around the dam. Generally, however, the dam is built for purposes of power or navigation, and part or all of the water flowing past it is diverted for such uses. This water is measured and added to that passing over the dam. To insure accuracy in such determinations of flow the amount of water diverted should be reasonably constant. Furthermore, it should be so diverted that it can be measured, either by a weir, a current meter, or a simple system of water wheels which are of standard make, or which have been rated as meters under working conditions and so installed that the gate openings, the heads under which they work, and their angular velocities may be accurately observed.

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[a] Water-Supply Paper No. 200 replaces No. 150, the edition of which has been exhausted.

The combination of physical conditions and uses of water should be such that the determinations of flow will not involve, for a critical stage of considerable duration, the use of a head on a broad-crested dam, of less than 6 inches. Moreover, when all other conditions are good, the cooperation of the owners or operators of the plant is still essential if reliable results are to be obtained.

A gaging station at a weir or dam has the general advantage of continuity of record through the periods of ice and floods, and the disadvantages of uncertainty of coefficient to be used in the weir formula and of complications in the diversion and use of the water.

Velocity method.—The determination of the quantity of water flowing past a certain section of a stream at a given time is termed a discharge measurement. This quantity is the product of two factors—the mean velocity and the area of the cross section. The mean velocity is a function of surface slope, wetted perimeter, roughness of bed, and the channel conditions at, above, and below the gaging section. The area depends on the contour of the bed and the fluctuations of the water surface. The two principal ways of measuring the velocity of a stream are by floats and current meters.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements in order that the data may have the required degree of accuracy. Their essential requirements are practically the same whether the velocity is determined by meters or floats. They are located as far as possible where the channel is straight both above and below the gaging section; where there are no cross currents, backwater, or boils; where the bed of the stream is reasonably free from large projections of a permanent character; and where the banks are high and subject to overflow only at flood stages. The station must be so far removed from the effects of tributary streams and of dams or other artificial obstructions that the gage height shall be an index of the discharge.

Certain permanent or semipermanent structures, usually referred to as "equipment," are generally pertinent to a gaging station. These are a gage for determining the fluctuations of the water surface, bench marks to which the datum of the gage is referred, permanent marks on a bridge or a tagged line indicating the points of measurement, and, where the current is swift, some appliance (generally a secondary cable) to hold the meter in position in the water. As a rule, the stations are located at bridges if the channel conditions are satisfactory, as from them the observations can more readily be made and the cost of the equipment is small.

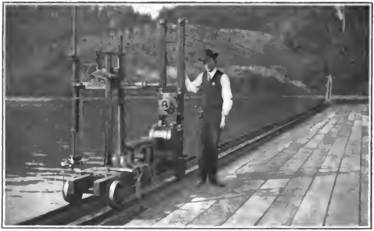
The floats in common use are the surface, subsurface, and tube or rod floats. A corked bottle with a flag in the top and weighted at the bottom makes one of the most satisfactory surface floats, as it is affected but little by wind. In case of flood measurements, good results can be obtained by observing the velocity of floating cakes of ice or débris. In case of all surface-float measurements coefficients must be used to reduce the observed velocity to the mean velocity. The subsurface and tube or rod floats are intended to give directly the mean velocity in the vertical. Tubes give excellent results when the channel conditions are good, as in canals.

In measuring velocity by a float, observation is made of the time taken by the float to pass over the "run," a selected stretch of river from 50 to 200 feet long. In each discharge measurement a large number of velocity determinations are made at different points across the stream, and from these observations the mean velocity for the whole section is determined. This may be done by plotting the mean positions of the floats as indicated by the distances from the bank as ordinates and the corresponding times as abscissas. A curve through these points shows the mean time of run at any point across the stream, and the mean time for the whole stream is obtained by dividing the area bounded by this curve and its axis by the width. The length of the run divided by the mean time gives the mean velocity.

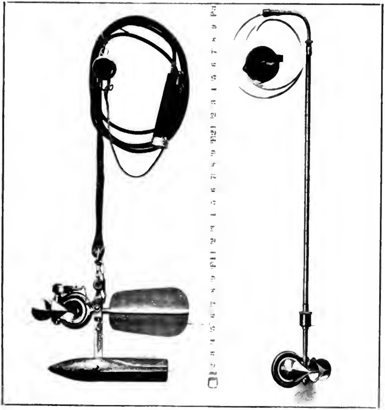
The area used in float measurements is the mean of the areas at the two ends of the run and at several intermediate sections.

The essential parts of the current meters in use are a wheel of some type so constructed that the impact of flowing water causes it to revolve and a device for recording or indicating the number of revolutions. The relation between the velocity of the moving water and the revolutions of the wheel is determined for each meter. This rating is done by drawing the meter through still water for a given distance at different speeds and noting the number of revolutions for each run. From these data a rating table is prepared which gives the velocity per second for any number of revolutions.

Many kinds of current meters have been constructed. They may, however, be classed in two general types—those in which the wheel is made up of a series of cups, as the Price, and those having a screw-propeller wheel, as the Haskell. Each meter has been developed for use under some special condition. In the case of the small Price meter, shown in Pl. II, *B*, which has been largely developed and extensively used by the United States Geological Survey, an attempt has been made to get an instrument which could be used under practically all conditions.



A. CURRENT-METER RATING STATION AT LOS ANGELES, CAL.



B. PRICE CURRENT METERS

Current-meter measurements may be made from a bridge, cable, boat, or by wading, and gaging stations may be classified in accordance with such use. Fig. 1 shows a typical cable station.

In making the measurement an arbitrary number of points are laid off on a line perpendicular to the thread of the stream. The points at which the velocity and depth are observed are known as measuring points and are usually fixed at regular intervals, varying from 2 to 20 feet, depending on the size and condition of the stream. Perpendiculars dropped from the measuring points divide the gaging section into strips. For each strip or pair of strips the mean velocity, area, and discharge are determined independently, so that conditions existing in one part of the stream may not be extended to parts where they do not apply.

Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

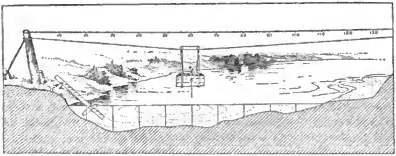


FIG. 1.—Cable station showing section of the river, car, gage, etc.

The three principal multiple-point methods in general use are the vertical velocity-curve; 0.2 and 0.8 depth; and top, bottom, and mid-depth.

In the vertical velocity-curve method a series of velocity determinations are made in each vertical at regular intervals, usually from 0.5 to 1 foot apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points the vertical velocity-curve is developed. This curve shows, graphically, the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. On account of the length of time required to make a complete measurement by this method its use is limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 of the depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. On the assumption that the vertical velocity-curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 of the depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this second multiple-point method gives the mean velocity very closely for open-water conditions, and, moreover, the indications are that it holds nearly as well for ice-covered rivers.

In the third multiple-point method the meter is held at mid-depth, at 0.5 foot below the surface, and at 0.5 foot above the bottom, and the mean velocity is determined by dividing by 6 the sum of the top velocity, four times the mid-depth velocity, and the bottom velocity. The method may be modified by observing at 0.2, 0.6, and 0.8 depth.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth for which the coefficient for reducing to mean velocity has been determined.

Extensive experiments by vertical velocity-curves show that the thread of mean velocity generally occurs at from 0.3 to 0.7 of the total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, at which point the meter is held in a majority of the measurements. A large number of vertical velocity-curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity.

In the other principal single-point method the meter is held near the surface, usually 1 foot below or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be from 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is specially adapted for flood measurements or when the velocity is so great that the meter can not be kept at 0.6 depth.

The vertical-integration method consists in moving the meter at a slow uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods.

The area, which is the other factor in the velocity method of determining the discharge of a stream, depends on the stage of the river, which is observed on the gage, and on the general contour of the bed of the stream, which is determined by soundings. The soundings are usually taken at each measuring point at the time of the discharge measurement either by using the meter and cable or by a special sounding line or rod. For streams with permanent beds standard cross sections are usually taken during low water. These sections serve to check the soundings which are taken at the time of the measurements, and from them any change which may have taken place in the bed of the stream can be detected. They are also of value in obtaining the area for use in computations of high-water measurements, as accurate soundings are hard to obtain at high stages.

In computing the discharge measurements from the observed velocities and depths at various points of measurement the measuring section is divided into elementary strips, as shown in fig. 1, and the mean velocity, area, and discharge are determined separately for either a single or a double strip. The total discharge and the area are the sums of those for the various strips, and the mean velocity is obtained by dividing the total discharge by the total area.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period, and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8, and vertical velocity-curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, the thickness and character of the ice, etc. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice.

For information in regard to flow under ice cover see Water-Supply Paper No. 187.

OFFICE METHODS OF COMPUTING RUN-OFF.

There are two principal methods of determining run-off, depending upon whether or not the bed of the stream is permanent.

For stations of streams with permanent beds the first step in computing the run-off is the construction of a rating table, which shows the discharge corresponding to any stage of the stream. This rating table is applied to the record of stage to determine the amount of water flowing. The construction of the rating table depends on the method used in measuring flow.

For a station at a weir or dam the basis for the rating table is some standard weir formula. The coefficients to be used in its application depend on the type of dam and other conditions near its crest. After inserting in the weir formula the measured length of crest and the assumed coefficient, the discharge is computed for various heads and the rating table constructed.

The data necessary for the construction of a rating table for a velocity-area station are the results of the discharge measurements, which include the record of stage of the river at the time of measurement, the area of the cross section, the mean velocity of the current, and the quantity of water flowing. A thorough knowledge of the conditions at and in the vicinity of the station is also necessary.

The construction of the rating table depends on the following laws of flow for open permanent channels: (1) The discharge will remain constant so long as conditions at or near the gaging station remain constant. (2) The discharge will be the same whenever the stream is at a given stage if the change of slope due to the rise and fall of the stream be neglected. (3) The discharge is a function of and increases gradually with the stage.

The plotting of results of the various discharge measurements, using gage heights as ordinates; and discharge, mean velocity, and area as abscissas will define curves which show the discharge, mean velocity, and area corresponding to any gage height. For the development of these curves there should be, therefore, a sufficient number of discharge measurements to cover the range of the stage of the stream. Fig. 2 shows a typical rating curve with its corresponding mean-velocity and area curves.

As the discharge is the product of two factors, the area and the mean velocity, any change in either factor will produce a corresponding change in the discharge. Their curves are therefore constructed in order to study each independently of the other.

The area curve can be definitely determined from accurate soundings extending to the limits of high water. It is always concave toward the horizontal axis or on a straight line, unless the banks of the stream are overhanging.

The form of the mean-velocity curve depends chiefly on the surface slope, the roughness of the bed, and the cross section of the stream. Of these, the slope is the principal factor. In accordance with the relative changes of these factors the curve may be either a straight line, convex or concave toward either axis, or a combination of the three. From a careful study of the conditions at any gaging station the form which the vertical velocity-curve will take can be predicted, and it may be extended with reasonable certainty to stages beyond the limits of actual measurements. Its principal use is in connection with the area curve in locating errors in discharge measurements and in constructing the rating table.

The discharge curve is defined primarily by the measurements of discharge, which are studied and weighted in accordance with the local conditions existing at the time of each measurement. The curve may,

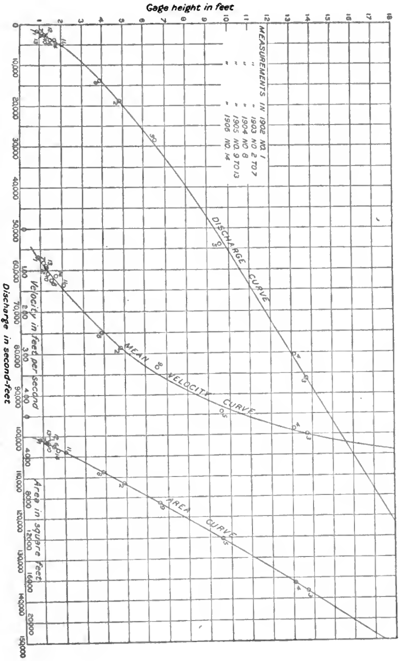


Fig. 2.—Typical discharge, area, and mean-velocity curves.

however, best be located between and beyond the measurements by means of curves of area and mean velocity. The discharge curve under normal conditions is concave toward the horizontal axis and is generally parabolic in form.

In the preparation of the rating table the discharge for each tenth or half tenth on the gage is taken from the curve. The differences between successive discharges are then taken and adjusted according to the law that they shall be either constant or increasing.

The determination of daily discharge of streams with changeable beds is a difficult problem. In case there is a weir or dam available, a condition which seldom exists on streams of this class, the discharge can be determined by its use. In case of velocity-area stations frequent discharge measurements must be made if the determinations of flow are to be other than rough approximations. For stations with beds which shift slowly, or are materially changed only during floods, rating tables can be prepared for periods between such changes and satisfactory results obtained with a limited number of measurements, provided that some of them are taken soon after the change occurs. For streams with continually shifting beds, such as the Colorado and Rio Grande, discharge measurements should be made every two or three days and the discharges for intervening days obtained either by interpolation modified by gage height or by Professor Stout's method, which has been described in full in the Nineteenth Annual Report of the United States Geological Survey, Part IV, page 323, and in the Engineering News of April 21, 1904. This method, or a graphical application of it, is also much used in determining the flow at stations where the bed shifts but slowly.

COOPERATION AND ACKNOWLEDGMENTS.

Special acknowledgments are due to John H. Lewis, State engineer of Oregon, for cooperation in accordance with the provisions of section 10, chapter 228, Laws of Oregon for 1905, "Hydrographic and topographic surveys in cooperation with the United States Government," which provides $2,500 annually for hydrographic surveys, "such appropriations, however, being contingent upon the United States Government making a like apportionment for such purposes to be expended within the State."

In 1906 the cooperative fund of $2,500 appropriated by the State of Oregon was largely spent under the direction of the State engineer in western Oregon, the Geological Survey retaining supervision of the work and publishing the results without expense to the State; but the Federal Survey, realizing the benefits to be derived by a more extensive study of the water resources of the State than could be accomplished by merely meeting the State's appropriation, expended on hydrographic work in Oregon the sum of $5,533 during the calendar year 1906.

Assistance has been rendered or records furnished by the following, to whom acknowledgments are due:

The officers and employees of the United States Weather Bureau; Corps of Engineers, U. S. Army; Meteorological Service of Department of Marine and Fisheries, Canada; for climatological and hydrographic data.

Oregon Railroad and Navigation Company; Southern Pacific Company; Oregon Short Line Railroad; Northern Pacific Railroad; Sumpter Valley Railway; and Columbia Southern Railway; for transportation.

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COLUMBIA RIVER DRAINAGE.

COLUMBIA RIVER PROPER.

DESCRIPTION OF BASIN.

Columbia River has its source in Columbia Lake in the east division of the Kootenai district in British Columbia; thence it flows northward to the fifty-second parallel of latitude, where it turns sharply southward and flows through a series of arrowlike lakes, crossing the international boundary line in the northeast corner of the State of Washington, where it receives the Clark Fork. After traversing the State of Washington it forms the boundary line between Washington and Oregon and empties into the Pacific Ocean at the forty-sixth parallel of latitude. The river is navigable in long stretches throughout its entire course in the United States, although, owing to rapids and falls, continuous navigation is not possible.

16565

The Columbia and its tributaries drain a total area of 259,000 square miles, distributed as follows:

Areas in Columbia River basin.

	Square miles.
Oregon	55,370
Washington	48,000
Idaho	81,380
Montana	25,000
Nevada	5,280
Wyoming	5,270
British Columbia	38,700

The larger part of this area is arid or semiarid, the annual rainfall varying from 10 inches in portions of Oregon and Idaho to 100 inches on the Cascade Range. The area is largely mountainous, and the streams flow for the most part through deep canyons in the basaltic formations characteristic of the Pacific Northwest. The flood discharge of the Columbia at The Dalles has been estimated at 1,000,000 second-feet and the low-water flow at about 40,000 second-feet.

The tributaries of the Columbia are of great importance, affording good sites for the development of power and an abundance of water for irrigation, which latter is extensively practiced in some of the valleys, notably those of Umatilla, Yakima, and the upper portion of Snake River.

The basins of Naches, Boise, and Walla Walla rivers and other tributary streams are described in connection with gaging stations maintained on them.

On the Columbia proper but one gaging station—that at Pasco—is maintained by the Geological Survey. Others, however, are maintained by the United States Weather Bureau at Riparia, Wenatchee, Umatilla, The Dalles, and Vancouver, and by the United States Corps of Engineers at Celilo, Cascade Locks, and Fort Stevens.

COLUMBIA RIVER AT PASCO, WASH.

This station was established October 15, 1904, at the bridge of the Northern Pacific Railway, 1.2 miles from Pasco, Wash. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 13, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Columbia River at Pasco, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.7	8.0	9.3	11.4	17.8	21.0	19.7	17.6	12.9	11.6	11.0	11.8
2	7.7	8.1	9.2	12.2	18.1	20.9	19.7	17.4	12.8	11.5	10.8	11.7
3	7.6	8.2	9.2	13.0	18.5	20.8	19.7	17.4	12.8	11.4	10.8	11.6
4	7.6	8.2	9.2	13.0	18.8	20.8	19.7	17.2	12.8	11.3	10.8	11.4
5	7.6	8.3	9.1	12.8	19.2	21.0	19.7	17.0	12.7	11.2	10.7	11.3
6	7.6	8.3	9.0	12.6	19.3	21.0	19.7	16.8	12.7	11.1	10.6	11.2
7	7.6	8.2	9.0	12.6	19.2	21.1	19.7	16.5	12.7	11.0	10.6	11.1
8	7.6	8.1	8.9	13.0	19.1	21.1	19.8	16.1	12.6	10.9	10.6	11.1
9	7.5	8.1	9.0	13.4	19.0	21.0	19.9	15.9	12.6	10.9	10.7	11.1
10	7.6	8.0	9.1	13.9	19.0	20.9	20.1	15.6	12.6	10.8	10.9	11.1
11	7.4	7.9	9.1	14.4	19.3	20.8	20.3	15.4	12.5	10.7	10.7	11.0
12	7.4	7.9	9.2	14.4	19.7	20.8	20.4	15.3	12.8	10.6	10.8	11.0
13	7.4	7.9	9.2	14.3	20.1	20.9	20.5	15.1	13.2	10.6	10.9	11.0
14	7.6	7.9	9.0	14.1	20.3	21.1	20.6	15.0	13.5	10.5	11.4	11.0
15	7.5	7.9	8.9	13.8	20.3	21.1	20.6	15.0	13.7	10.5	14.0	10.9
16	7.6	7.8	8.8	13.8	20.2	21.0	20.6	15.0	13.7	10.5	16.6	10.8
17	7.4	7.8	8.7	14.0	20.2	21.0	20.5	15.0	13.5	10.5	17.5	10.6
18	7.4	7.8	8.4	14.3	20.1	21.1	20.4	15.0	13.3	10.5	16.3	10.6
19	7.4	7.8	8.3	14.6	20.0	20.9	20.2	15.0	13.1	10.6	15.3	10.5
20	7.4	8.0	8.3	14.9	20.0	20.7	20.0	15.0	12.8	10.6	14.0	10.4
21	7.4	8.8	8.3	15.1	19.9	20.5	19.9	14.9	12.6	10.6	13.3	10.6
22	7.4	9.0	8.3	15.3	19.9	20.1	19.7	14.7	12.4	10.6	13.1	11.4
23	7.3	9.2	8.3	15.9	19.9	20.0	19.4	14.6	12.2	10.6	12.9	11.4
24	7.4	9.3	8.3	16.6	19.9	19.8	19.2	14.4	12.0	10.5	12.8	11.3
25	7.4	9.3	8.4	17.2	19.9	19.6	19.0	14.3	12.0	10.5	12.6	11.3
26	7.6	9.3	8.7	17.6	20.0	19.5	18.8	14.0	12.0	10.4	12.4	11.4
27	7.8	9.3	9.4	17.6	20.2	19.3	18.6	13.8	11.9	10.3	12.2	11.7
28	8.0	9.3	10.2	17.5	20.8	19.3	18.4	13.6	11.8	11.2	12.0	11.7
29	8.0	......	10.9	17.4	20.8	19.3	18.2	13.4	11.7	11.7	11.9	11.8
30	8.0	......	11.3	17.5	20.8	19.6	18.0	13.2	11.7	11.4	11.9	11.6
31	8.0	......	11.2	......	21.0	......	17.9	13.0	......	11.1	......	11.6

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made on minor streams directly tributary to Columbia River during 1906:

Miscellaneous measurements in Columbia River drainage basin in 1906.

Date.	Stream.	Locality.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 10	Eightmile Creek	The Dalles, Oreg.	......	......	......	[a] 7
April 26	Sandy River	3½ miles southeast of Troutdale, Oreg.	202	1,320	......	3,050
July 27	do	do	180	774	[b] 1.18	703
August 31 [c]	do	Salmon River post-office, Oreg.	88	154	1.15	397
September 1	do	Troutdale, Oreg.	178	750	[b] 1.55	475
September 30	do	do	183	844	[d] 4.87	688
September 27	Still River	SW. ¼ sec. 13, T. 3 S., R. 7 E.	20	22	......	53
August 31	Salmon River	Salmon River post-office, Oreg.	71	117	......	120
September 27	Zigzag Creek	NE. ¼ sec. 17, T. 3 S., R. 7 E.	22	14	[e] 2.80	44
September 1	Bull Run Creek	Above Portland waterworks pipe intake.	74	183	......	93
September 1	do	do	74	177	......	110
June 30	Bull Run Creek pipe	Headworks	14.5	52	......	38
September 1	do	do	14.5	46	......	38

[a] Estimated.
[b] Below top portion of lower section of bridge caisson, right bank.
[c] Below junction of Salmon River.
[d] Below top of bridge caisson, left bank, downstream side.
[e] Below nail in alder on south bank 20 feet upstream from footbridge.

CLARK FORK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Clark Fork[a] rises on the eastern slopes of the high mountain ranges that form the boundary between Montana and Idaho. It flows northward, northwestward, and again northward as it crosses western Montana, northern Idaho (through Lake Pend Oreille), northeastern Washington, and a few miles into British Columbia, then turns somewhat abruptly westward and southwestward and joins the Columbia near Boundary station on the Spokane Falls and Northern Railroad.

To the river thus described various names have been applied in the past and are probably still used locally. The northward-flowing section above the town of Missoula has been known as the Bitterroot, the section between the junction of Hell Gate and Big Blackfoot rivers and Lake Pend Oreille has been called the Missoula, and the stretch of the river below its exit from Lake Pend Oreille has been called Pend Oreille River. These names, as well as Silver Bow, Hell Gate, and Deer Lodge, have been superseded, a recent decision of the Board on Geographic Names applying Clark Fork to the stream continuously from the head of the Bitterroot to the mouth of the Pend Oreille.

CLARK FORK[b] NEAR GRANTSDALE, MONT.

This station was established April 25, 1902. It is located on the highway bridge 2 miles southwest of Grantsdale and 5 miles southwest of Hamilton, Mont. Length of chain in 1906, 23.25 feet. The bench mark is the northwest bolt in the northwest abutment of the bridge; elevation above gage datum, 19.36 feet. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 21, where are given also references to publications that contain data for previous years.

Discharge measurements of Clark Fork near Grantsville, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 7	Morse and Edson	172	403	2.26	798
April 27	G. Edson	186	567	3.27	1,970
June 5	do	193	744	4.10	3,830
July 7	Morse and Richards	183	486	2.95	1,460
August 11[c]	R. Richards	29	57	1.24	99
September 9[c]	do	37	56	1.24	114

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[a] Clark Fork; river in Idaho, Montana, and Washington. (Not Bitter Root, Bitterroot, Clarke, Clarks River, Deer Lodge, Deerlodge, Hell Gate, Hellgate, Missoula, Silver Bow, nor Silverbow:) Third Report U. S. Board on Geographic Names, Washington, 1907, p. 51.

[b] Station formerly known as Bitterroot River near Grantsdale, Mont.

[c] Measured by wading.

Daily gage height, in feet, of Clark Fork near Grantsdale, Mont., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	1.5	1.6	2.35	3.3	3.6	3.0	1.4	1.3	1.4	2.1	2.15
2	1.8	1.5	1.6	2.25	3.2	3.5	3.0	1.5	1.3	1.4	2.0	2.15
3	1.8	1.5	1.6	2.15	3.4	3.5	3.1	1.4	1.3	1.4	2.0	2.1
4	1.8	1.7	1.6	1.95	3.8	4.0	3.1	1.3	1.2	1.4	2.0	2.1
5	1.8	1.7	1.6	1.95	3.6	4.0	3.0	1.3	1.2	1.5	1.9	2.1
6	1.8	1.6	1.6	2.25	3.5	4.1	3.0	1.6	1.2	1.5	1.9	2.5
7	1.8	1.6	1.6	2.35	3.5	3.9	3.0	1.5	1.2	1.5	1.9	2.4
8	1.8	1.5	1.6	2.35	3.7	3.7	2.9	1.4	1.2	1.5	2.95	2.35
9	1.9	1.8	1.7	2.45	3.8	3.5	2.8	1.3	1.2	1.5	2.7	2.35
10	1.9	1.8	1.7	2.45	4.0	4.0	2.8	1.3	1.2	1.5	2.5	2.3
11	1.9	1.8	2.5	2.35	4.2	4.3	2.6	1.2	1.2	1.5	2.4	2.3
12	2.3	1.8	2.5	2.35	4.2	4.4	2.6	1.3	1.3	1.5	3.0	2.25
13	2.3	1.7	2.5	2.25	4.3	4.1	2.5	1.2	1.4	1.5	4.1	2.2
14	2.3	1.7	2.5	2.25	4.1	4.0	2.4	1.2	1.5	1.5	4.6	2.1
15	2.3	1.6	2.5	2.55	4.0	3.9	2.3	1.2	1.5	1.5	6.02	2.05
16	2.3	1.6	2.5	2.55	3.8	3.7	2.2	1.2	1.5	1.6	5.0	2.15
17	1.8	1.6	2.5	2.65	3.7	3.6	2.1	1.2	1.5	1.75	4.05	2.15
18	1.7	1.5	2.3	2.65	3.6	3.5	2.2	1.2	1.5	1.7	3.55	2.1
19	1.8	1.5	2.2	2.65	3.4	3.4	2.1	1.2	1.5	1.7	3.25	2.1
20	1.8	1.6	2.0	2.75	3.3	3.3	2.0	1.1	1.6	1.7	3.0	2.1
21	1.8	1.6	1.8	3.05	3.5	3.2	1.9	1.1	1.6	1.65	2.7	2.2
22	1.7	1.6	1.8	3.45	3.4	3.1	1.9	1.3	1.6	1.6	2.6	2.25
23	1.7	1.6	1.8	3.85	3.4	3.0	1.9	1.4	1.6	1.65	2.5	2.25
24	1.7	1.6	1.7	4.15	3.5	3.0	1.8	1.4	1.5	1.65	2.35	2.2
25	1.6	1.6	2.1	3.85	4.0	3.1	1.7	1.5	1.5	1.7	2.3	2.2
26	1.6	1.6	2.0	3.45	4.3	3.2	1.7	1.5	1.5	1.9	2.3	2.25
27	1.6	1.6	2.0	3.25	4.4	3.3	1.5	1.5	1.5	2.9	2.25	2.3
28	1.6	1.6	2.0	3.2	4.3	3.8	1.5	1.4	1.4	2.7	2.25	2.3
29	1.6	....	2.0	3.3	4.0	3.5	1.3	1.4	1.4	2.5	2.2	2.25
30	1.5	....	2.0	3.3	3.9	3.4	1.4	1.3	1.4	2.4	2.15	2.35
31	1.5	....	2.2	....	3.8	....	1.3	1.3	....	2.2	....	2.4

Note.—Ice conditions January 12 to 17 and February 9 to March 21.

Rating table for Clark Fork near Grantsdale, Mont., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	60	1.80	395	2.50	1,020	3.20	1,825	3.90	3,005
1.20	80	1.90	470	2.60	1,120	3.30	1,965	4.00	3,215
1.30	110	2.00	550	2.70	1,225	3.40	2,105	4.20	3,660
1.40	150	2.10	635	2.80	1,335	3.50	2,265	4.40	4,110
1.50	200	2.20	725	2.90	1,450	3.60	2,435		
1.60	260	2.30	820	3.00	1,570	3.70	2,615		
1.70	325	2.40	920	3.10	1,695	3.80	2,805		

Note.—The above table is applicable only for open-channel conditions. It is based on 17 discharge measurements made during 1904–1906 and is well defined.

Monthly discharge of Clark Fork near Grantsdale, Mont., for 1906.

[Drainage area, 1,550 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January [a]	470	200	359	22,100	0.232	0.27
February 1-8	325	200	246	3,900	.159	.05
March 22-31	725	325	522	10,400	.337	.13
April	3,550	510	1,370	81,500	.884	.99
May	4,110	1,825	2,800	172,000	1.81	2.09
June	4,110	1,570	2,540	151,000	1.64	1.83
July	1,700	110	866	53,200	.559	.64
August	260	60	127	7,810	.082	.09
September	260	80	157	9,340	.101	.11
October	1,450	150	386	23,700	.249	.29
November	8,100	470	1,650	98,200	1.06	1.18
December	1,020	592	750	46,100	.484	.56
The period	....	....	....	679,000	....	....

[a] Discharge estimated January 12 to 17.

Note.—Values are rated as follows: January to March and August to October, good; remainder of the period, excellent.

CLARK FORK[a] AT MISSOULA, MONT.

This station was established July 10, 1898, at Higgins Avenue Bridge, Missoula, Mont., but was removed May 27, 1899, to the bridge of the Bitterroot Valley division of the Northern Pacific Railway, about one-half mile downstream. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 16, where are given also references to publications that contain data for previous years.

Discharge measurements of Clark Fork at Missoula, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 6	Morse and Edson	195	833	3.43	1,750
April 6	do	195	813	3.45	1,650
April 26	G. Edson	275	1,250	4.90	4,290
June 6	do	306	1,480	6.08	7,370
July 6	Morse and Richards	172	912	4.13	2,690
August 10	R. Richards	162	715	3.08	1,070
September 8	do	137	699	2.77	1,050
September 19	Grover and Follansbee	162	733	3.07	1,050
October 15	Richards and Follansbee	162	723	2.93	972

Daily gage height, in feet, of Clark Fork at Missoula, Mont., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.10	3.30	2.80	4.12	4.52	5.70	4.70	3.08	3.05	2.85	3.25	3.60
2	3.10	3.30	2.68	4.18	4.50	5.60	4.62	3.02	3.00	2.90	3.20	3.60
3	3.10	3.35	2.60	3.78	4.58	5.65	4.62	3.00	3.00	2.90	3.20	3.60
4	3.10	3.35	2.65	3.50	4.80	5.72	4.48	3.00	3.00	2.85	3.25	3.62
5	3.10	3.35	2.70	3.42	4.85	5.95	4.32	3.00	2.98	2.90	3.20	3.78
6	3.10	3.35	2.80	3.45	4.80	6.02	4.25	3.00	2.90	2.90	3.20	3.70
7	3.10	3.35	2.90	3.60	4.65	6.12	4.10	3.00	2.85	2.90	3.22	3.72
8	3.10	3.35	2.95	3.70	4.62	5.95	4.00	3.10	2.78	2.90	3.45	3.75
9	3.12	3.35	2.95	3.75	4.75	5.80	3.98	3.15	2.78	2.85	3.60	3.70
10	3.15	3.35	2.95	3.72	4.80	5.72	3.95	3.15	2.75	2.85	3.60	3.65
11	3.15	3.35	2.95	3.68	5.00	5.72	3.88	2.95	2.85	2.90	3.65	3.68
12	3.20	3.35	2.95	3.62	5.25	5.72	3.80	2.95	2.85	2.90	3.60	3.75
13	3.20	3.35	2.95	3.58	5.38	5.78	3.72	3.00	2.85	2.95	3.68	3.80
14	3.20	3.35	2.95	3.52	5.40	5.78	3.60	3.05	2.90	2.95	4.20	3.68
15	3.20	3.35	2.95	3.52	5.30	5.62	3.65	3.00	3.18	2.95	5.00	3.48
16	3.20	3.35	2.95	3.60	5.30	5.48	3.70	3.00	3.32	2.95	5.18	3.45
17	3.20	3.35	3.15	3.72	5.15	5.60	3.62	2.92	3.22	3.05	5.15	3.48
18	3.20	3.35	3.25	3.80	5.00	5.50	3.58	2.82	3.08	3.08	4.70	3.58
19	3.25	3.35	3.25	3.88	4.85	5.28	3.50	2.82	3.10	3.10	4.48	3.70
20	3.25	3.35	3.40	3.90	4.80	5.10	3.45	2.80	3.05	3.15	4.28	3.68
21	3.10	3.35	3.40	4.00	4.80	5.02	3.40	2.78	3.08	3.10	4.35	3.65
22	3.30	2.90	3.30	4.25	4.88	4.98	3.40	2.75	3.05	3.05	4.22	3.60
23	3.30	2.80	3.30	4.55	4.90	4.90	3.35	3.10	3.00	3.05	4.15	3.60
24	3.30	2.70	3.98	4.90	4.90	4.80	3.30	3.25	2.98	3.05	4.02	3.60
25	3.30	2.60	3.95	5.00	4.98	4.78	3.22	3.28	2.92	3.05	4.00	3.65
26	3.30	2.80	4.35	4.88	4.98	4.70	3.20	3.35	2.95	3.22	3.98	3.75
27	3.30	2.80	4.25	4.80	5.10	4.60	3.12	3.30	2.95	3.30	3.70	3.80
28	3.30	2.80	3.95	4.75	5.30	4.70	3.10	3.22	2.95	3.25	3.60	3.80
29	3.30	....	3.90	4.70	5.55	4.80	3.10	3.15	2.90	3.25	3.70	3.75
30	3.30	....	3.85	4.62	5.78	4.78	3.10	3.10	2.90	3.25	3.60	3.70
31	3.30	....	3.92	....	5.75	....	3.10	3.08	....	3.25	....	3.60

NOTE.—Ice conditions January 2 to February 19 and March 10 to 24. There was no ice during December.

[a] Station formerly known as Missoula River at Missoula, Mont.

Rating table for Clark Fork at Missoula. Mont., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.50	750	3.30	1,440	4.10	2,610	4.90	4,230	5.60	5,990
2.60	810	3.40	1,560	4.20	2,790	5.00	4,460	5.70	6,270
2.70	880	3.50	1,600	4.30	2,970	5.10	4,700	5.80	6,550
2.80	950	3.60	1,830	4.40	3,160	5.20	4,950	5.90	6,840
2.90	1,030	3.70	1,970	4.50	3,360	5.30	5,200	6.00	7,130
3.00	1,120	3.80	2,120	4.60	3,570	5.40	5,460	6.20	7,740
3.10	1,220	3.90	2,280	4.70	3,780	5.50	5,720	6.40	8,370
3.20	1,330	4.00	2,440	4.80	4,000				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 9 discharge measurements made during 1906 and is well defined between gage heights 3.5 feet and 6.0 feet. Below gage height 3.5 feet the table is only fair.

Monthly discharge of Clark Fork at Missoula, Mont., for 1906.

[Drainage area, 5,960 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
February 20-28	1,500	810	1,060	18,900	0.178	0.06
March [a]	3,060	810	1,480	91,000	.248	.29
April	4,460	1,590	2,560	152,000	.430	.48
May	6,490	3,360	4,510	277,000	.757	.87
June	7,490	3,570	5,510	328,000	.924	1.03
July	3,780	1,220	2,060	127,000	.346	.40
August	1,500	915	1,170	71,900	.196	.23
September	1,460	915	1,100	65,500	.185	.21
October	1,440	990	1,150	70,700	.193	.22
November	4,900	1,330	2,360	140,000	.396	.44
December	2,120	1,620	1,920	118,000	.322	.37
The period				1,460,000		

[a] Open channel rating applied March 10 to 24.

NOTE.—Values are rated as follows: February, March, and August to December, fair; April to July, good.

STILLWATER RIVER NEAR KALISPELL, MONT.

Stillwater River rises in the northern part of Flathead County and flows southeast through several lakes into Flathead River.

The gaging station was established September 25, 1906. The gage is located at the Reiter wagon bridge, 2 miles from Kalispell. The flow is controlled by dams above. The measuring section is below the mouth of Whitefish River and includes the flow of that stream. The intake for the city waterworks is between the mouth of Whitefish and the gage. Owing to the extreme sluggishness of the Stillwater above the mouth of the Whitefish, it is impossible to make measurements; hence the flow of the former is obtained by subtracting the flow at the Whitefish station from that at this station. This gives the amount available for irrigation.

Discharge measurements are made from the bridge or may be made by wading at low stage.

The gage, which is read morning and evening by W. H. Reiter, is a staff, fastened to the upstream end of the bridge pier. The bench mark is a spike in the piling which is the upstream edge of the pier on which the right end of the right truss rests; it is 3 feet above the ground and is driven horizontally; elevation, 4.74 feet above gage datum.

Discharge measurements of Stillwater River near Kalispell, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 25	Follansbee and Wade	90	305	1.64	142
October 2	Follansbee and Richards	98	309	1.52	125
November 22[a]	R. Richards	67	107	2.12	322

[a] Measured by wading.

Daily gage height, in feet, of Stillwater River near Kalispell, Mont., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		1.95	1.50	2.58	12		1.95	1.70	1.70	23		1.85	1.75	2.10
2		1.80	2.02	2.50	13		1.41	1.75	1.95	24		1.82	1.65	1.80
3		2.10	2.20	2.50	14		1.21	1.85	2.32	25	1.65	1.35	2.30	1.68
4		1.85	1.45	2.42	15		1.71	2.05	2.28	26	1.60	1.92	2.75	2.05
5		1.70	2.00	2.45	16		1.70	3.25	2.28	27	1.72	2.22	2.70	1.55
6		1.68	2.05	2.40	17		1.56	3.05	2.28	28	1.95	2.15	2.65	1.95
7		1.56	1.70	1.98	18		1.56	2.95	2.30	29	2.32	1.95	2.62	1.70
8		1.31	1.60	1.75	19		1.60	2.32	2.25	30	2.40	1.38	2.58	1.70
9		1.90	1.35	1.72	20		1.51	2.02	2.25	31		1.98		1.58
10		1.86	2.00	1.70	21		1.28	2.00	2.20					
11		1.60	1.90	1.70	22		1.15	2.00	2.20					

NOTE.—The flow of this stream is controlled by dams.

Rating table for Stillwater River near Kalispell, Mont., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	67	1.60	140	2.10	310	2.60	670	3.10	1,200
1.20	77	1.70	163	2.20	370	2.70	760	3.20	1,320
1.30	89	1.80	190	2.30	430	2.80	860	3.30	1,450
1.40	104	1.90	220	2.40	500	2.90	970		
1.50	120	2.00	260	2.50	580	3.00	1,080		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906.

Monthly discharge of Stillwater River near Kalispell, Mont., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
September 25-30	500	140	274	3,260
October	382	72	178	10,900
November	1,380	95	410	24,400
December	658	136	327	20,100
The period				58,660

NOTE.—Values are rated as follows: September, October, and December, good; November, fair.

WHITEFISH RIVER NEAR KALISPELL, MONT.

Whitefish River rises in the central part of Flathead County and flows south into Stillwater River above the gaging station on that stream.

The gaging station was established September 24, 1906. It is located at the Tetrault wagon bridge 10 miles from Kalispell and 6 miles from Columbia Falls. There is a dam at the outlet of the lake which feeds the river, and consequently the flow is wholly controlled.

The channel is straight for 500 feet above, and 200 feet below the station. The banks are high and are not likely to overflow. The bed of the stream is composed of gravel and is permanent. There is one channel at all stages.

Discharge measurements are made from the wagon bridge or may be made by wading at low stage.

The gage, which is read daily by F. R. Miles, is a staff fastened to timber abutment 200 feet upstream from the bridge, on the left bank. The bench mark is a black paint spot on a bowlder on the right bank, near the water's edge and directly downstream from old timber abutment; it is marked "U. S. G. S. B. M."; elevation, 3.02 feet above the gage datum.

Discharge measurements of Whitefish River near Kalispell, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 24[a].	Wade and Follansbee	106	99.7	2.28	126
October 22[b].	Follansbee and Richards	26	19.1	1.35	14.8
November 22[b].	R. Richards	32	25.0	1.70	15.9

[a] Made at bridge. [b] Made by wading.

Daily gage height, in feet, of Whitefish River near Kalispell, Mont., for 1906.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		2.95	8		1.6	17	2.0		24	2.5	
2		2.95	11	1.4		18	2.0		25	2.6	
3		2.9	12	1.4		19	2.2		26	2.6	
4		2.85	13	1.4		20	2.3		27	2.8	
5		2.8	14	1.4		21	2.4		28	3.0	
6		2.65	15	1.6		22	2.4		29	3.0	
7		1.65	16	1.9		23	2.4		30	3.0	

CROW CREEK NEAR RONAN, MONT.

Crow Creek rises on the western slope of the Mission Range and flows westward across the Flathead Reservation, emptying into Clark Fork.

The gaging station was established September 21, 1906. It is located at the highway bridge on the stage road from St. Ignatius to Ronan, 4 miles south of Ronan. The station is several miles below the canyon.

The channel curves sharply to the right immediately above the station, but is straight for 200 feet below. The banks slope back gradually from the water's edge. At all stages except extreme flood the water will all pass beneath the bridge. The current is sluggish. The bed of the stream is composed of fine gravel.

Discharge measurements are made by wading at a section either above or below the bridge. At high stages measurements may be made at the bridge.

The gage, which is read morning and evening by Mrs. Alphonsine McIntyre, is a staff fastened to the upstream end of the bridge pier. The bench mark is a spike driven horizontally 2 feet above the ground, in the northeast corner of a log building, 50 feet downstream from the gage, on the left bank; elevation, 10 feet above the datum of the gage.

Discharge measurements of Crow Creek near Ronan, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 20[a]	Wade and Follansbee	33	56.5	1.00	24.9
October 18[b]	Follansbee and Richards	28	28.9	1.15	35.7
November 19[b]	R. Richards	28	39.0	1.86	73.5

[a] Made at bridge. [b] Made by wading.

Daily gage height, in feet, of Crow Creek River near Ronan, Mont., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		0.9	1.0	1.25	12		1.0	1.3	1.0	22	1.0	1.0	1.5	1.1
2		.9	1.0	1.2	13		1.05	1.6	1.0	23	.95	1.0	1.45	1.05
3		1.2	1.0	1.15	14		1.0	1.8	1.05	24	.9	1.0	1.4	......
4		1.15	1.0	1.15	15		1.0	2.2	1.15	25	.9	1.0	1.4	......
5		1.0	1.0	1.15	16		1.1	2.95	1.05	26	.9	1.15	1.25	1.6
6		1.0	1.0	1.1	17		1.15	2.2	1.0	27	.9	1.3	1.1	1.4
7		1.0	1.0	1.05	18		1.2	2.0	1.0	28	1.0	1.2	1.2	1.35
8		1.0	1.3	1.1	19		1.1	1.9	1.0	29	.95	1.2	1.2	1.3
9		1.0	1.3	1.1	20		1.05	1.8	1.0	30	.9	1.1	1.2	1.3
10		1.0	1.3	1.0	21	1.0	1.0	1.6	1.0	31	......	1.1	......	1.2
11		1.0	1.3	1.0										

Rating table for Crow Creek near Ronan, Mont., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	22	1.40	48	1.80	71	2.20	96	2.60	126
1.00	27	1.50	53	1.90	76	2.30	103	2.70	134
1.10	32	1.60	59	2.00	82	2.40	110	2.80	143
1.20	37	1.70	65	2.10	89	2.50	118	2.90	152
1.30	42								

NOTE.—The above table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Crow Creek near Ronan, Mont., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
September 21–30	27	22	23.9	474
October	42	22	29.9	1,840
November	156	27	51.5	3.060
December	59	27	34.2	2,100
The period				7,470

NOTE.—Values are only approximate on account of the small number of measurements.

MISSION CREEK NEAR ST. IGNATIUS, MONT.

Mission Creek rises on the western slope of the Mission Range and flows across the Flathead Reservation into Clark Fork.

The station was established September 21, 1906. It is located opposite the home of A. A. Booke, 1 mile downstream from St. Ignatius. There are a few small ditches diverting water above the gage.

The channel curves both above and below the station. The right bank is low and liable to overflow; the left is high and will not overflow. The current is swift. The bed is composed of gravel and is permanent. There is one channel at all stages.

Discharge measurements are made from the footbridge to which the staff gage is attached. The gage, which is 6 or 8 miles below the canyon, is read morning and evening by Mrs. A. A. Booke. The bench mark is a large spike driven horizontally in a pine tree 27 feet back of the gage on the left bank, below a blaze in the tree and 1 foot above the ground; elevation, 7.05 feet above the gage datum.

Discharge measurements of Mission Creek near St. Ignatius, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 21	Wade and Follansbee	30	25.8	0.78	65.4
October 17	Follansbee and Richards	29	25.9	.76	56.5
November 19	R. Richards	28	21.5	.66	46.5

Daily gage height, in feet, of Mission Creek near St. Ignatius, Mont., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		0.7	0.7	0.5	12		0.7	0.65	0.55	23	0.75	0.65	0.65	0.55
2		.7	.7	.55	13		.7	.7	.55	24	.75	.65	.6	.55
3		.7	.7	.55	14		.7	.75	.55	25	.7	.65	.6	.6
4		.7	.7	.55	15		.7	.82	.55	26	.7	.68	.6	.6
5		.7	.7	.55	16		.7	.82	.55	27	.7	.72	.6	.6
6		.7	.68	.55	17		.72	.72	.55	28	.7	.75	.58	.6
7		.7	.75	.55	18		.72	.7	.55	29	.7	.75	.55	6
8		.7	.7	.55	19		.72	.65	.55	30	.7	.7	.52	.55
9		.75	.7	.55	20		.7	.7	.55	31		.7		.55
10		.7	.65	.55	21	0.8	.7	.65	.55					
11		.7	.65	.55	22	.8	.7	.65	.55					

Rating table for Mission Creek near St. Ignatius, Mont., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	33	0.60	40	0.70	50	0.80	65	0.90	85

NOTE.—The above table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Mission Creek near St. Ignatius, Mont., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
September 21-30	65	50	54.4	1,080
October	57	45	50.5	3,110
November	69	34	48.1	2,860
December	40	33	36.5	2,240
The period				9,290

NOTE.—Values are only fair on account of the small number of measurements.

POST CREEK NEAR ST. IGNATIUS, MONT.

Post Creek rises on the western slope of the Mission Range and flows across Flathead Reservation into Mission Creek, a tributary of Clark Fork.

The gaging station was established September 21, 1906. It is located at the upper highway bridge, near the home of Joseph Allard, 10 miles north of St. Ignatius. The station is near the canyon and only two small ditches divert above. Because of the storage possibilities of McDonald Lake, the source of Post Creek, and also because of the land which can be reached, this station is very important.

The channel is straight for 25 feet above and 100 feet below the gage. The current is very swift. Both banks are wooded and will not overflow. The bed of the stream is composed of gravel and small bowlders and is permanent. There is one channel at all stages.

Discharge measurements are made from the downstream side of the highway bridge.

The gage, which is read twice each day by Mrs. Adaline Allard, is a staff fastened to the overhanging stump at the right end of the bridge. The bench mark is a headless spike, 2 feet above the ground, in a blaze in a pine tree 2 feet in diameter, 45 feet from the left bank and 18 feet from the road; elevation, 8.90 feet above the gage datum.

Discharge measurements of Post Creek near St. Ignatius, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 21	Grover and Follansbee	22	24.0	1.50	63.2
October 17	Follansbee and Richards	22	23.4	1.51	58.8
November 19	R. Richards	25	29.6	1.73	70.7

Daily gage height, in feet, of Post Creek near St. Ignatius, Mont., for 1906.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1		1.4	1.5	1.4	12		1.5	1.8	1.3	22	1.5	1.4	1.7	1.3
2		1.4	1.4	1.4	13		1.4	1.8	1.3	23	1.4	1.4	1.65	1.3
3		1.3	1.4	1.3	14		[a]1.4	1.9	1.3	24	1.5	1.4	1.55	1.3
4		1.4	1.4	1.3	15		[a]1.4	2.0	1.3	25	1.5	1.4	1.5	1.3
5		1.5	1.5	1.3	16		[a]1.5	2.0	1.3	26	[a]1.5	1.4	1.5	1.3
6		1.4	1.5	1.3	17		1.5	1.9	1.3	27	1.5	1.4	1.45	1.3
7		1.4	1.5	1.3	18		1.5	1.8	1.3	28	1.4	1.4	1.4	1.3
8		1.4	1.6	1.3	19		1.6	1.7	1.3	29	1.4	1.4	1.4	1.3
9		1.4	1.6	1.3	20		1.5	1.7	1.3	30	1.4	1.5	1.4	1.3
10		1.4	1.7	1.3	21	1.5	1.4	1.7	1.3	31		1.5		1.3
11		1.4	1.7	1.3										

[a] Interpolated.

Rating table for Post Creek near St. Ignatius, Mont., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	50	1.50	59	1.70	69	1.90	81	2.00	88
1.40	54	1.60	64	1.80	75				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Post Creek near St. Ignatius, Mont., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
September 21-30	59	54	57.0	1,130
October	64	50	55.5	3,410
November	88	54	65.5	3,900
December	54	50	50.3	3,090
The period				11,530

NOTE.—Values are only fair on account of the small number of measurements.

JOCKO RIVER AT RAVALLI, MONT.

Jocko River rises in the southeastern part of Flathead Reservation and flows northwest into Clark Fork.

The gaging station, which was established October 18, 1906, is located 400 feet downstream from a point opposite the railroad station at Ravalli.

The channel is straight for several hundred feet above and below the gage. Both banks are sparsely wooded and will not overflow except at very high stage. The current is swift, and small rapids occur a short distance below the gage. The bed of the stream is composed of gravel and small bowlders and is permanent. There is one channel at all stages.

Discharge measurements may be made from the highway bridge 1 mile upstream, or preferably by wading at or near the gage. In high water the bridge must be used.

The gage, which is read daily by H. F. Lynn, the station agent, is a staff fastened to an overhanging tree on the right bank. The bench mark is a nail 2 feet above the ground in a tree 25 feet northeast of the gage; elevation, 6.80 feet above the datum of the gage.

Discharge measurements of Jocko River at Ravalli, Mont., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 18[a]	Follansbee and Richards	46	80	1.69	150
November 20[b]	R. Richards	67	120	2.14	317

[a] Measured at bridge.

[b] Measured by wading at gage.

Daily gage height, in feet, of Jocko River at Ravalli, Mont., for 1906.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1		1.75		12		1.8	1.85	22	1.65	1.85	1.8
2		1.75	1.8	13		2.1	1.8	23	1.65	1.85	1.8
3		1.7	1.8	14		2.15	1.8	24	1.65	1.85	1.8
4		1.7	1.8	15		2.75	1.8	25	1.65	1.85	1.8
5		1.7	1.8	16		2.7	1.8	26	2.0	1.85	1.85
6		1.7	1.8	17		2.5	1.8	27	2.1	1.8	1.9
7		1.7	1.85	18	1.65	2.3	1.8	28	1.95	1.8	1.9
8		1.85	1.8	19	1.65	2.1	1.75	29	1.9	1.8	1.85
9		1.8	1.8	20	1.65	1.95	1.8	30	1.8	1.8	
10		1.8	1.8	21	1.65	1.9	1.8	31	1.8		
11		1.8	1.85								

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Clark Fork drainage basin in 1906:

Miscellaneous measurements in Clark Fork drainage basin.

Date.	Stream.	Locality.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 20	Mud Creek	Highway bridge near Ronan, Mont.	8	4.5	1.51	2.55
September 25	South Fork of Flathead River.	Columbia Falls, Mont	195	312		649

SPOKANE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Spokane River has its source in Lake Coeur d'Alene, Idaho, flows westward through Washington for about 120 miles, and empties into Columbia River. Its drainage area consists of rough mountainous land, more or less timbered, interspersed here and there with valleys or level table-lands of tillable areas.

The rainfall in this basin is approximately 20 inches per annum, and the region is semiarid. The principal tributary streams are Hangman Creek, Little Spokane, and Chamokane rivers.

The waters of the streams are largely used for irrigation, power, and municipal water supply. The city of Spokane is furnished with an abundance of electric power from plants at Spokane, Wash., and Post Falls, Idaho. The waters of Little Spokane River are in great demand for irrigation development.

SPOKANE RIVER AT SPOKANE, WASH.

This gaging station was originally established October 17, 1896, on the Oregon Railroad and Navigation Company's wooden bridge, about 1 mile above the falls, where discharge measurements and gage readings were taken until July 8, 1903, the gage datum being 1,880 feet above sea level by city datum and 1,865 feet by Government datum.

March 30, 1904, a cable station was established about one-half mile above the Mission Street Bridge, or 1 mile above the former station at the Oregon Railroad and Navigation Company's bridge. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 25, where are given also references to publications that contain data for previous years.

The following measurement was made October 1, 1906:

Width, 195 feet; area, 1,630 square feet; gage height, 1.28 feet; discharge, 1,330 second-feet.

Daily gage height, in feet, of Spokane River at Spokane, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.16	2.83	5.40	5.63	8.91	6.31	4.16	2.15	1.64	1.40	1.81	3.27
2	2.16	2.96	5.38	6.10	8.81	6.37	4.07	2.10	1.70	1.59	1.84	3.24
3	2.14	3.10	5.32	6.36	8.71	6.41	3.96	2.09	1.54	1.52	1.90	3.20
4	2.13	3.21	5.24	6.62	8.60	6.41	3.87	2.14	1.53	1.46	1.67	3.15
5	2.00	3.32	5.20	6.77	8.60	6.37	3.81	1.73	1.63	1.49	1.53	3.28
6	2.03	3.50	5.12	6.80	8.51	6.31	3.72	1.80	1.59	1.54	1.82	[a] 3.90
7	2.26	3.49	5.04	6.90	8.37	6.23	3.66	1.92	1.58	1.60	1.76	3.65
8	2.17	3.80	4.98	7.09	8.22	6.16	3.59	1.95	1.63	1.35	1.97	3.61
9	2.19	3.79	4.96	7.30	8.05	6.12	3.53	2.05	1.85	1.55	2.05	3.74
10	2.17	3.74	4.95	7.55	7.90	5.98	3.38	1.78	1.60	1.47	2.07	3.76
11	2.18	3.75	4.93	7.78	7.77	5.92	3.29	1.76	1.63	1.46	1.93	4.00
12	2.19	3.74	4.91	7.90	7.71	5.82	3.16	1.73	1.65	1.51	1.70	3.65
13	2.21	3.72	4.90	7.97	7.68	5.80	3.06	1.73	1.56	1.45	1.94	3.43
14	2.22	3.56	4.86	8.00	7.60	5.73	2.96	1.76	1.50	1.56	1.80	3.49
15	2.24	3.40	4.83	7.93	7.55	5.62	2.92	1.80	1.56	1.35	1.90	3.46
16	2.23	3.37	4.82	7.91	7.44	5.51	2.89	1.84	1.53	1.63	2.91	3.43
17	2.25	3.32	4.70	7.92	7.32	5.41	2.83	1.91	1.50	1.53	2.67	3.38
18	2.24	3.34	4.60	8.02	7.18	5.32	2.85	1.75	1.58	1.70	3.03	3.44
19	2.24	3.38	4.52	8.08	7.00	5.21	2.65	1.56	1.67	1.65	[a] 4.59	3.38
20	2.21	3.70	4.45	8.11	6.85	5.11	2.73	1.77	1.62	1.71	3.72	3.45
21	2.21	4.11	4.37	8.31	6.70	5.01	2.58	1.76	1.43	1.70	4.20	3.43
22	2.22	4.47	4.31	8.33	6.55	4.93	2.50	1.95	1.43	1.63	4.56	3.50
23	2.24	4.74	4.22	8.48	6.46	4.83	2.47	1.76	1.42	1.65	3.90	3.48
24	2.26	4.97	4.18	8.80	6.35	4.74	2.49	1.63	1.40	1.63	4.03	3.51
25	2.29	5.10	4.18	9.18	6.25	4.64	2.38	1.64	1.65	1.68	4.06	3.92
26	2.36	5.24	4.24	9.23	6.02	4.52	2.34	1.70	1.53	1.66	4.07	4.20
27	2.47	5.33	4.35	9.31	6.04	4.45	2.25	1.63	1.57	1.62	4.05	4.55
28	2.62	5.39	4.60	9.22	6.03	4.36	2.26	1.76	1.57	1.81	4.01	5.00
29	2.67	......	4.80	9.11	5.94	4.32	2.18	1.65	1.62	1.54	3.91	5.50
30	2.73	......	5.03	9.04	6.00	4.25	2.26	1.68	1.60	1.70	3.81	5.65
31	2.78	......	5.30	......	6.05	......	2.21	1.60	......	1.73	......	5.70

[a] Backwater due to log jams.

NOTE.—The river at this point does not freeze on account of the underground flow of water which comes through the gravel above the station and into the river again.

Rating table for Spokane River at Spokane, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	1,000	2.10	2,340	3.20	4,080	4.60	6,600	6.80	11,340
1.10	1,100	2.20	2,490	3.30	4,250	4.80	7,050	7.00	11,830
1.20	1,200	2.30	2,640	3.40	4,420	5.00	7,450	8.00	14,490
1.30	1,300	2.40	2,790	3.50	4,600	5.20	7,850	9.00	17,380
1.40	1,410	2.50	2,940	3.60	4,780	5.40	8,250	10.00	20,580
1.50	1,520	2.60	3,100	3.70	4,960	5.60	8,660	11.00	23,980
1.60	1,640	2.70	3,260	3.80	5,140	5.80	9,080	12.00	27,580
1.70	1,760	2.80	3,420	3.90	5,330	6.00	9,510		
1.80	1,900	2.90	3,580	4.00	5,520	6.20	9,950		
1.90	2,040	3.00	3,740	4.20	5,900	6.40	10,400		
2.00	2,190	3.10	3,910	4.40	6,280	5.60	10,860		

NOTE.—The above table is based on 22 discharge measurements made during 1904-1907 and is well defined between gage heights 1.4 feet and 12.0 feet.

Monthly discharge of Spokane River at Spokane, Wash., for 1906.

[Drainage area, 4,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	3,390	2,190	2,600	160,000	0.650	0.75
February	8,230	3,470	5,320	295,000	1.33	1.38
March	8,250	5,860	7,050	433,000	1.75	2.03
April	18,400	8,720	14,200	845,000	3.55	3.96
May	17,100	9,380	12,800	787,000	3.20	3.69
June	10,400	6,000	8,440	502,000	2.11	2.35
July	5,820	2,460	3,790	233,000	.948	1.09
August	2,420	1,590	1,920	118,000	.480	.55
September	1,970	1,410	1,610	95,800	.402	.45
October	1,910	1,360	1,520	99,600	.405	.47
November	5,640	1,560	3,600	214,000	.900	1.00
December	8,870	4,000	5,210	320,000	1.30	1.50
The year	18,400	1,360	5,680	4,100,000	1.42	19.22

NOTE.—Values are rated as excellent.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Spokane River drainage basin in 1906:

Spokane River.—A measurement was made at low water October 1, 1906, at Spokane Bridge, near the Idaho-Washington State line.

Width, 163 feet; area, 778 square feet; discharge, 803 second-feet.

A measurement was made at medium stage November 12, 1906, in sec. 24, T. 27 N., R. 39 E.

Width, 154 feet; area, 760 square feet; discharge, 2,500 second-feet.

OKANOGAN RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Okanogan River rises in Okanogan Lake, in British Columbia, and flows southward, entering Columbia River near Brewster, Wash. Its course in Canada lies through a series of narrow lakes. The drainage area is comparatively rough and mountainous, and is timbered except along the river. The rainfall is approximately 20 inches per annum. The principal tributaries in the United States are Similkameen and Conconully rivers and Antwine, Bonaparte, Salmon, and Johnson creeks.

The main stream is navigable from Brewster to Riverside except during low-water periods, while the tributaries are used largely for irrigation.

SALMON CREEK NEAR MALOTT, WASH.

This station was established April 11, 1903. It is located opposite R. D. Jones's house, on the county road halfway between Malott and Conconully, Okanogan County. It is reached by way of the Great Northern Railway to Wenache, thence by way of the Columbia River steamers to Brewster, and by the Conconully stage from Brewster to Jones's ranch. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 32, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Salmon Creek near Malott, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.69	0.75	0.70	1.52	1.42	2.21	1.46	0.92	0.49	0.54	0.69	0.71
2	.68	.74	.69	1.33	1.38	2.02	1.40	.88	.46	.56	.69	.69
3	.67	.73	.68	1.25	1.44	2.00	1.33	.83	.46	.54	.71	.71
4	.69	.70	.66	1.29	1.33	2.29	1.29	.83	.44	.54	.83	.67
5	.70	.70	.68	1.40	1.25	2.00	1.25	.81	.44	.58	1.00	.67
6	.71	.69	.73	1.50	1.23	2.00	1.23	.81	.44	.54	.96	.67
7	.70	.70	.72	1.54	1.19	1.96	1.27	.79	.44	.56	.83	.69
8	.71	.65	.74	1.33	1.19	1.83	1.14	.75	.46	.60	.75	.67
9	.73	.65	.75	1.25	1.21	1.79	1.12	.75	.50	.56	.75	.71
10	.70	.58	.75	1.10	1.21	1.83	1.08	.75	.50	.54	.81	.73
11	.71	.60	.70	1.14	1.25	1.96	.98	.71	.57	.56	.79	.71
12	.71	.58	.68	1.11	1.25	2.12	1.00	.67	.54	.67	.79	.67
13	.73	.56	.70	1.12	1.29	2.02	.99	.67	.58	.67	.75	.69
14	.73	.58	.73	1.17	1.33	2.00	.92	.71	.60	.67	.81	.67
15	.70	.64	.70	1.21	1.77	1.96	.90	.67	.62	.69	1.38	.67
16	.69	.66	.70	1.31	1.41	1.83	.88	.66	.64	.73	1.12	.69
17	.67	.68	.66	1.31	1.29	1.83	.83	.58	.58	.67	.90	.69
18	.67	.66	.66	1.25	1.27	1.79	1.05	.56	.58	.67	.83	.71
19	.69	.70	.70	1.25	1.25	1.71	1.00	.54	.56	.64	.83	.71
20	.70	.75	.66	1.33	1.31	1.67	1.00	.52	.58	.67	.79	.73
21	.71	.75	.70	1.44	1.29	1.62	1.05	.54	.56	.62	.83	.71
22	.71	.87	.70	1.56	1.40	1.58	1.35	.58	.54	.67	.79	.73
23	.73	.77	.75	1.52	1.46	1.54	1.31	.66	.54	.67	.79	.73
24	.72	.75	.83	1.43	1.35	1.52	1.25	.58	.54	.67	.75	.67
25	.73	.73	.87	1.29	1.32	1.50	1.12	.56	.56	.67	.77	.67
26	.73	.75	.87	1.29	2.42	1.47	1.05	.56	.54	.67	.75	.54
27	.74	.73	.85	1.29	2.75	1.58	1.00	.54	.54	.71	.75	.46
28	.75	.70	.83	1.33	2.35	1.71	1.00	.54	.54	.69	.75	.50
29	.75	....	.82	1.33	2.10	1.54	.96	.52	.56	.67	.75	.71
30	.73	....	.86	1.35	2.08	1.46	.94	.50	.54	.67	.73	.67
31	.73	....	1.42	....	2.12	....	.92	.50	....	.67	....	.67

NOTE.—The creek never freezes at the gage.

JOHNSON CREEK NEAR RIVERSIDE, WASH.

This station was established May 30, 1903. The weir was destroyed July 30, 1904, and the station discontinued, but it was replaced April 30, 1905, and the records resumed. It is located at

Sogle's ranch, on the road from Riverside to Conconully, 1 mile from Riverside and 17 miles from Conconully.

The right bank of the stream is low for 10 feet back from the water's edge and then it rises more abruptly. The left bank is steep and rocky. The bed of the creek is composed of small gravel.

The equipment consists of a sharp-crested weir with an 8-foot opening and vertical sides. Below the level of the crest the weir consists of two 2-inch pine planks, 12 inches wide, securely spiked together. Above the crest on each end are two planks 12 inches wide, which form the ends of the weir. The edges of the crest and ends are one-fourth inch wide and beveled on the downstream side to an angle of 60°. The pool above the weir is 10 feet long, 10 to 15 feet wide, and 1 foot deep below the crest. The water has a fall of about 1 foot after passing the weir and then flows rapidly away.

The depth of the water on the crest is determined by a hook gage and vernier reading to thousandths of a foot. The zero on the gage is 0.10 foot above the crest of the weir. During 1905 and 1906 the gage readings were made once each day by Mrs. S. Sogle. The bench mark is the top of the fence opposite the weir; elevation, 12.91 feet above zero of the gage and 1,241.54 feet above sea level.

A description of this station, with discharge data, is contained in Water-Supply Papers Nos. 100 and 135, United States Geological Survey.

Daily discharge, in second-feet, of Johnson Creek at Riverside, Wash., for 1905–6.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1	......	......	......	......	11.7	6.3	10.8	6.2	6.1	8.3	8.0	9.5
2	......	......	......	......	11.6	6.3	10.4	6.7	6.2	8.3	8.0	11.3
3	......	......	......	......	11.4	9.0	9.9	6.3	6.4	7.6	8.0	11.4
4	......	......	......	......	11.1	10.4	8.8	6.2	5.8	7.4	7.9	11.5
5	......	......	......	......	11.0	9.1	8.1	6.1	6.1	8.1	7.9	7.9
6	......	......	......	......	10.7	8.8	6.8	6.0	5.9	8.7	7.9	7.9
7	......	......	......	......	10.7	8.9	6.5	5.8	5.9	9.3	7.9	8.0
8	......	......	......	......	10.6	8.7	6.5	5.6	6.0	8.1	8.0	7.9
9	......	......	......	......	11.1	8.1	5.6	5.4	6.4	7.5	8.0	8.4
10	......	......	......	......	10.8	8.0	5.6	5.4	6.2	7.3	8.1	8.5
11	......	......	......	......	10.7	9.5	4.6	6.1	6.1	7.2	8.1	8.4
12	......	......	......	......	9.7	8.3	5.1	5.8	6.1	7.1	8.0	8.4
13	......	......	......	......	9.5	7.6	5.0	5.8	8.3	6.9	8.1	8.4
14	......	......	......	......	6.8	7.1	6.6	5.6	8.5	6.8	8.3	8.0
15	......	......	......	......	6.1	6.9	6.6	5.8	6.9	7.8	8.3	8.9
16	......	......	......	......	7.7	6.9	4.6	6.0	7.0	7.4	8.4	8.3
17	......	......	......	......	7.7	6.8	6.8	6.2	7.6	7.4	8.4	8.3
18	......	......	......	......	6.4	6.8	7.6	6.2	7.4	7.5	8.4	8.7
19	......	......	......	......	5.9	6.8	6.4	6.1	7.0	7.9	12.5	9.0
20	......	......	......	......	6.2	6.7	5.0	5.8	7.2	7.9	12.1	8.8
21	......	......	......	......	6.7	6.6	5.3	5.6	7.3	7.9	9.7	8.7
22	......	......	......	......	7.1	6.8	5.1	5.4	7.1	7.9	8.8	8.0
23	......	......	......	......	9.5	6.6	5.1	5.4	6.3	8.0	8.7	7.6
24	......	......	......	......	9.6	7.3	5.1	5.6	6.3	8.1	8.6	9.0
25	......	......	......	......	7.1	9.0	5.1	6.5	6.3	7.9	8.7	8.4
26	......	......	......	......	8.1	9.5	5.1	6.6	7.3	7.9	8.7	8.4
27	......	......	......	......	7.2	13.6	5.4	6.7	12.5	7.9	8.3	8.1
28	......	......	......	......	7.2	12.2	6.0	6.7	12.3	7.9	7.9	8.0
29	......	......	......	......	7.1	11.5	7.0	6.4	9.1	8.0	7.9	7.9
30	......	......	......	......	4.6	10.8	6.6	5.7	8.0	8.0	9.2	7.9
31	......	......	......	......	6.1	......	6.2	6.0	......	8.0	......	8.8

Daily discharge, in second-feet, of Johnson Creek at Riverside, Wash., for 1905–6—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1906.												
1	4.6	10.1	9.6	12.2	3.7	6.4	3.0	1.0	3.5	4.1	4.8	6.1
2	8.3	9.8	9.5	9.8	3.3	5.9	3.2	1.3	3.4	4.1	4.9	6.3
3	8.1	9.7	9.5	9.1	2.8	4.8	2.4	1.3	3.1	4.2	5.1	6.4
4	7.9	9.5	9.6	8.8	2.8	6.8	2.4	1.0	3.0	4.2	6.8	6.4
5	7.9	9.2	9.5	8.7	1.8	6.1	4.1	1.0	2.6	4.3	8.1	6.6
6	7.9	8.5	9.5	8.6	2.1	5.8	3.0	1.9	2.8	4.4	5.7	7.3
7	6.3	8.9	9.5	8.5	2.3	5.6	3.1	1.3	2.8	4.6	5.6	7.1
8	8.1	8.5	9.5	8.5	1.9	5.3	3.0	1.4	3.1	4.2	5.7	6.9
9	8.2	8.4	9.2	8.4	2.8	5.3	1.6	1.4	3.1	4.2	6.0	6.6
10	7.9	8.3	9.0	8.4	2.7	4.9	1.6	1.3	3.1	4.2	6.8	6.5
11	14.1	8.3	8.1	8.3	3.5	5.1	1.5	1.4	3.2	4.3	6.8	6.9
12	8.4	8.2	7.7	8.4	3.4	5.8	1.3	1.4	3.4	4.4	5.7	6.8
13	8.6	8.3	8.8	8.4	3.0	5.4	1.3	1.4	4.6	4.4	5.9	6.6
14	8.5	8.1	8.3	8.4	2.9	5.6	1.3	1.9	4.9	4.6	8.4	6.6
15	8.0	8.6	7.6	8.3	5.7	5.7	1.3	1.7	4.9	4.4	7.3	5.6
16	8.2	8.8	9.5	8.3	4.5	6.8	1.3	1.6	4.4	4.5	7.3	5.5
17	8.0	10.4	8.7	8.1	4.5	6.2	1.4	1.4	4.1	4.5	6.6	6.7
18	8.1	12.5	8.5	8.0	3.9	5.6	3.1	1.4	4.4	4.4	6.4	8.5
19	33.6	17.5	8.2	8.0	3.5	5.2	3.3	1.7	4.2	4.4	6.0	7.9
20	10.1	13.8	8.5	8.0	3.4	5.2	2.4	1.7	4.3	4.5	6.1	7.3
21	7.6	15.8	8.7	8.0	1.9	5.0	2.2	1.7	4.2	4.6	6.1	7.2
22	7.9	13.2	8.8	7.6	2.0	4.8	2.8	2.2	4.2	4.5	6.2	7.4
23	9.2	11.3	8.8	7.9	3.3	4.7	2.7	2.6	4.2	4.5	6.1	7.3
24	10.1	10.7	9.2	7.9	3.7	4.7	2.6	2.6	4.4	4.6	6.0	7.2
25	10.1	12.2	9.0	8.0	3.9	4.2	2.2	2.4	4.4.	4.6	6.0	7.2
26	10.0	10.8	8.7	7.3	3.8	3.1	1.5	3.2	4.3	4.6	6.1	7.1
27	9.5	11.3	8.7	7.1	9.8	4.3	1.3	3.8	4.4	4.6	5.8	7.0
28	9.1	10.1	8.7	6.6	8.8	4.3	1.4	2.6	4.1	4.6	6.1	7.3
29	9.2	....	8.7	5.7	7.1	3.5	1.0	2.6	4.1	4.5	6.1	7.3
30	9.4	....	9.0	5.6	4.9	3.2	1.0	3.0	4.1	4.8	6.0	7.1
31	9.6	....	13.0	....	6.6	....	1.4	3.2	....	4.7	....	3.4

NOTE.—These discharges were obtained from the Cippoletti weir formula, using the gage heights corrected to give the head on crest of weir.

Monthly discharge of Johnson Creek at Riverside, Wash., for 1905–6.

[Drainage area, 66 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
May	11.7	4.6	8.64	531	0.131	0.15
June	13.6	6.3	8.36	497	.127	.14
July	10.8	4.6	6.43	395	.097	.11
August	6.7	5.4	5.99	368	.091	.10
September	12.5	5.8	7.19	428	.109	.12
October	9.3	6.8	7.81	480	.118	.14
November	12.5	7.9	8.56	509	.130	.14
December	11.5	7.6	8.65	532	.131	.15
The period	....	....	....	3,740	....	....
1906.						
January	33.6	4.6	9.44	580	.143	.16
February	17.5	8.1	10.4	578	.158	.16
March	13.0	7.6	9.02	555	.137	.16
April	12.2	5.6	8.16	486	.124	.14
May	9.8	1.8	3.88	239	.059	.07
June	6.8	3.1	5.18	308	.078	.09
July	3.3	1.0	2.12	130	.032	.04
August	3.8	1.0	1.88	116	.028	.03
September	4.9	2.6	3.84	228	.058	.06
October	4.8	4.1	4.44	273	.067	.08
November	8.4	4.8	6.22	370	.094	.10
December	8.5	3.4	6.78	417	.103	.12
The year	33.6	1.0	5.95	4,280	.090	1.21

NOTE.—Values for 1905–6 are excellent.

METHOW RIVER DRAINAGE BASIN.

METHOW RIVER AT PATEROS, WASH.

Methow River heads on the eastern slope of the Cascade Range in northern Washington and flows southeast into the Columbia River. Its drainage area throughout is mountainous and heavily timbered. The rainfall varies from 40 inches at the headwaters to 20 inches near the mouth of the stream. The waters of the smaller tributaries are largely used for irrigation.

This station was originally established May 3, 1903, on a highway bridge about 1,000 feet above the mouth of the river; the first two measurements were taken from this bridge. During the summer of 1903 the bridge was washed away, and a temporary bridge 400 feet farther downstream was used in making the measurement of March 20, 1904. During the spring of 1904 this bridge also was abandoned because of its temporary nature and the poor section at this point, and a cable station was established about a mile above the mouth of the river. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 35, where are given also references to publications that contain data for previous years.

The following measurement was made December 29, 1906. There was a narrow strip of ice on each bank.

Width, 154 feet; area, 342 feet; gage height, 4.12 feet; discharge, 489 second-feet.

Daily gage height, in feet, of Methow River at Pateros, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.9	3.9	3.9	4.55	7.35	8.3	6.4	4.65	4.15	4.0	4.45	4.35
2	3.9	3.9	3.9	4.55	7.5	8.3	6.5	4.6	4.15	4.0	4.4	4.35
3	3.9	3.9	3.95	4.55	7.8	8.3	6.6	4.55	4.1	4.0	4.4	4.35
4	[a] 4.1	3.9	3.95	4.65	7.6	9.5	6.7	4.55	4.1	4.0	4.45	4.35
5	4.1	3.9	3.95	4.8	7.2	8.5	6.75	4.55	4.05	4.0	4.45	4.35
6	4.1	3.9	3.95	5.2	7.0	8.2	6.85	4.55	4.05	4.0	4.45	4.35
7	4.1	3.8	3.95	5.7	6.95	7.8	7.0	4.45	4.05	3.95	4.4	4.35
8	3.95	3.8	3.95	5.8	7.0	7.5	6.6	4.45	4.05	3.95	4.45	4.35
9	3.95	3.8	4.0	5.65	7.1	7.0	6.4	4.45	4.05	3.95	4.4	4.35
10	3.95	3.8	4.0	5.5	7.2	7.3	6.25	4.45	4.1	3.95	4.45	4.35
11	3.95	3.9	4.0	5.4	7.75	7.3	6.15	4.4	4.1	3.95	4.65	4.35
12	4.0	4.0	3.9	5.3	7.8	8.3	6.0	4.4	4.1	3.95	4.65	4.35
13	4.15	4.0	3.9	5.2	7.8	8.0	5.95	4.4	4.1	3.95	4.65	4.35
14	4.45	3.95	3.9	5.2	7.1	7.6	5.8	4.4	4.1	3.95	4.7	4.0
15	4.1	3.95	3.95	5.3	7.3	7.2	5.7	4.4	4.1	4.0	5.3	4.25
16	4.1	3.95	3.95	5.5	7.0	7.4	5.6	4.4	4.1	4.05	5.15	4.25
17	4.1	3.95	3.95	5.5	6.9	7.1	5.5	4.35	4.1	4.05	4.9	4.25
18	4.1	4.0	3.95	5.6	6.7	6.8	5.4	4.3	4.1	4.05	4.8	4.2
19	4.1	4.0	3.95	5.7	6.65	6.75	5.35	4.25	4.1	4.05	4.7	4.15
20	4.1	4.05	3.95	5.7	6.6	6.7	5.25	4.25	4.1	4.05	4.65	4.15
21	4.1	4.0	3.95	6.1	6.6	6.7	5.2	4.2	4.05	4.0	4.6	4.2
22	4.1	3.95	3.95	6.8	6.6	6.65	5.15	4.25	4.05	4.0	4.55	4.2
23	4.2	3.95	3.95	7.0	6.65	6.6	5.05	4.25	4.05	4.0	4.5	4.2
24	4.25	3.95	4.0	6.8	6.75	6.55	5.0	4.25	4.05	4.0	4.5	4.2
25	4.15	3.95	4.05	6.5	6.75	6.75	4.95	4.25	4.05	4.0	4.5	4.2
26	4.15	3.95	4.05	6.3	10.5	7.25	4.9	4.25	4.05	3.95	4.45	4.0
27	4.15	3.9	4.1	6.3	10.5	7.4	4.85	4.2	4.05	4.6	4.45	4.05
28	4.1	3.95	4.15	6.35	9.2	7.4	4.8	4.2	4.05	4.55	4.4	4.05
29	4.0	....	4.15	6.35	9.0	7.0	4.8	4.15	4.0	4.55	4.35	4.1
30	3.9	....	4.25	6.95	8.7	6.6	4.75	4.15	4.0	4.5	4.35	4.15
31	3.9	....	4.5	....	8.4	....	4.7	4.15	....	4.5	....	4.15

[a] Ice forming along banks, narrowing channel.

Rating table for Methow River at Pateros, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.80	400	4.80	902	5.80	1,988	6.80	3,560	8.60	7,088
3.90	420	4.90	984	5.90	2,128	6.90	3,738	8.80	7,506
4.00	450	5.00	1,072	6.00	2,272	7.00	3,920	9.00	7,930
4.10	486	5.10	1,166	6.10	2,420	7.20	4,294	9.20	8,356
4.20	528	5.20	1,266	6.20	2,572	7.40	4,676	9.40	8,785
4.30	576	5.30	1,372	6.30	2,726	7.60	5,066	9.60	9,215
4.40	630	5.40	1,484	6.40	2,884	7.80	5,460	9.80	9,646
4.50	690	5.50	1,602	6.50	3,050	8.00	5,860	10.00	10,080
4.60	756	5.60	1,724	6.60	3,216	8.20	6,264		
4.70	826	5.70	1,854	6.70	3,386	8.40	6,674		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1906 and is well defined.

Monthly discharge of Methow River at Pateros, Wash., for 1906.

[Drainage area, 1,710 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec-ft. per sq. mile.	Depth in inches.
January	660	420	478	29,400	0.28	0.32
February	468	400	430	23,900	.25	.26
March	600	420	455	28,000	.27	.31
April	3,920	723	1,970	117,000	1.15	1.28
May	11,200	3,220	5,040	310,000	2.95	3.40
June	9,000	3,130	4,770	284,000	2.79	3.11
July	3,920	826	1,990	122,000	1.16	1.34
August	791	507	613	37,700	.36	.42
September	507	450	564	33,600	.33	.37
October	756	435	492	30,300	.29	.33
November	1,370	603	749	44,600	.44	.49
December	603	450	549	33,800	.32	.37
The year	11,200	400	1,510	1,090,000	.88	12.00

NOTE.—Values are good.

CHELAN RIVER DRAINAGE BASIN.

Chelan River forms the outlet of Lake Chelan, a long, narrow lake fed at the upper end by Stehekin River, which drains a portion of the eastern slopes of the Cascades. The tributaries of this lake drain a rough, mountainous area, quite heavily timbered. The lower end of the lake is 380 feet above Columbia River, to which it is joined by Chelan River, about 4 miles in length. The water supply of this stream is particularly valuable for future power development.

CHELAN RIVER AT CHELAN, WASH.

This station was established November 6, 1903, by G. H. Bliss. It is located at the highway bridge 3,000 feet below the outlet of the lake and in the town of Chelan. A dam which has been constructed at the foot of the lake by the town of Chelan holds back the flow of water to some extent during the dry season. The conditions at the station and the bench marks are described in Water-Supply Paper

No. 178, page 38, where are given also references to publications that contain data for previous years.

The following measurement was made January 2, 1907:

Width, 206 feet; area, 1,460 feet; gage height, 5.50 feet; discharge, 920 second-feet.

Daily gage height, in feet, of Chelan River at Chelan, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.40	5.70	5.60	5.85	7.75	8.45	7.65	7.20	6.20	5.75	5.55	7.15
2	5.40	5.68	5.60	5.90	7.90	8.45	7.70	7.15	6.15	5.70	5.50	7.10
3	5.40	5.65	5.60	5.90	8.05	8.50	7.80	7.15	6.10	5.70	5.45	7.05
4	5.40	5.65	5.60	5.90	8.20	8.45	8.00	7.05	6.10	5.65	5.40	7.00
5	5.40	5.65	5.60	5.95	8.30	8.40	8.15	7.00	6.00	5.60	5.40	7.00
6	5.38	5.65	5.55	6.02	8.35	8.40	8.25	6.50	5.95	5.60	5.40	7.00
7	5.38	5.65	5.55	6.40	8.30	8.35	8.40	6.50	5.90	5.55	5.40	6.95
8	5.40	5.65	6.65	6.40	8.30	8.35	8.50	6.50	5.90	5.50	5.40	6.95
9	5.40	5.65	6.58	6.50	8.32	8.35	8.50	6.50	5.90	5.55	5.50	6.90
10	5.40	5.65	6.50	6.48	8.40	8.30	8.45	6.50	5.85	5.55	5.50	6.90
11	5.40	5.60	6.43	6.52	8.50	8.30	8.40	6.50	5.90	5.60	5.55	6.85
12	5.45	5.60	6.38	6.50	8.65	8.35	8.40	6.50	6.00	5.60	5.65	6.80
13	5.48	5.60	6.30	6.50	8.70	8.35	8.38	6.45	6.25	5.60	5.80	6.70
14	5.48	5.60	6.25	6.50	8.70	8.30	8.35	6.45	6.15	5.60	6.10	6.60
15	5.45	5.65	6.22	6.55	8.70	8.30	8.35	6.40	6.10	5.60	6.50	6.55
16	5.50	5.65	6.20	6.60	8.65	8.25	8.35	6.40	6.00	5.60	7.00	6.50
17	5.45	5.65	6.18	6.65	8.60	8.20	8.33	6.35	5.95	5.60	7.50	6.40
18	5.45	5.65	6.10	6.60	8.55	8.15	8.30	6.35	5.95	5.57	7.70	6.40
19	5.40	5.65	6.00	6.70	8.50	8.10	8.20	6.30	5.95	5.55	7.60	6.35
20	5.40	5.65	5.92	6.75	8.40	7.95	8.10	6.28	5.95	5.50	7.50	6.35
21	5.40	5.60	5.88	6.82	8.30	7.75	8.00	6.25	5.90	5.45	7.45	6.30
22	5.40	5.65	5.85	7.00	8.25	7.65	7.90	6.20	5.90	5.40	7.40	6.30
23	5.90	5.65	5.82	7.15	8.20	7.50	7.80	6.15	5.90	5.40	7.40	6.30
24	5.85	5.70	5.80	7.25	8.15	7.40	7.70	6.08	5.85	5.38	7.40	6.20
25	5.85	5.65	5.80	7.35	8.20	7.50	7.60	6.00	5.90	5.80	7.35	6.10
26	5.80	5.70	5.78	7.40	8.35	7.60	7.00	6.00	5.85	5.85	7.35	6.00
27	5.80	5.70	5.78	7.42	8.45	7.70	7.55	6.05	5.85	5.90	7.30	5.90
28	5.75	5.65	5.75	7.45	8.50	7.70	7.50	6.05	5.80	5.80	7.25	5.90
29	5.75	....	5.72	7.50	8.50	7.68	7.50	6.10	5.78	5.65	7.20	5.85
30	5.70	....	5.72	7.60	8.50	7.65	7.40	6.20	5.75	5.65	7.20	5.80
31	5.70	....	5.82	....	8.50	....	7.30	6.20	....	5.60	....	5.70

Rating table for Chelan River at Chelan, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
5.30	830	6.00	1,150	6.70	1,920	7.30	2,910	7.90	3,990
5.40	860	6.10	1,230	6.80	2,070	7.40	3,090	8.00	4,170
5.50	900	6.20	1,320	6.90	2,230	7.50	3,270	8.20	4,550
5.60	940	6.30	1.420	7.00	2,390	7.60	3,450	8.40	4,930
5.70	990	6.40	1,530	7.10	2,560	7.70	3,630	8.60	5,300
5.80	1,040	6.50	1,650	7.20	2,730	7.80	3,810	8.80	5,690
5.90	1,090	6.60	1.780						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1907, and is fairly well defined above gage height 5.5 feet.

Monthly discharge of Chelan River at Chelan, Wash., for 1906.

[Drainage area, 950 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,090	854	916	56,300	.964	1.11
February	990	940	965	53,600	1.02	1.06
March	1,850	920	1,170	71,900	1.23	1.42
April	3,450	1,050	1,990	118,000	2.09	2.33
May	5,500	3,720	4,890	301,000	5.15	5.94
June	5,110	3,090	4,330	258,000	4.56	5.09
July	5,110	2,910	4,210	259,000	4.43	5.11
August	2,730	1,150	1,620	99,600	1.71	1.97
September	1,370	992	1,130	67,200	1.19	1.33
October	1,080	812	921	56,600	.969	1.12
November	3,630	830	1,990	118,000	2.09	2.33
December	2,640	965	1,750	108,000	1.84	2.12
The year	5,500	812	2,160	1,570,000	2.27	30.93

Note.—Values are good.

WENATCHEE RIVER DRAINAGE BASIN.

WENATCHEE RIVER AT CASHMERE, WASH.

Wenatchee River drains a portion of the western slope of the Cascade Mountains in Washington, and flows southeast through Lake Wenatchee into the Columbia River. Its basin throughout is mountainous and quite heavily timbered. The rainfall varies from 50 inches at the crest of the Cascades to 20 inches at the mouth. The waters of the stream are principally valuable for irrigation.

This station was established July 26, 1904. It is located at the highway bridge just north of the town of Cashmere, Wash. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 40, where are given also references to publications that contain data for previous years.

The old gage was destroyed by flood November 15, 1906. A new gage was installed at the same place and datum on December 27.

Discharge measurements of Wenatchee River at Cashmere, Wash., in 1906.

Date.	Hydrographer	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 23	W. G. Steward	160	232	1.55	889
August 29	do	161	737	1.55	956
December 27	H. McGlashan	186	312	2.20	1,300

Daily gage height, in feet, of Wenatchee River at Cashmere, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.3	2.4	2.0	3.6	6.0	4.6	3.6	2.2	1.8	1.5	3.2	......
2	1.3	2.5	2.0	3.5	6.1	4.6	3.8	2.1	1.8	1.4	2.9	......
3	1.4	2.6	2.0	3.3	6.3	4.9	4.1	2.0	1.7	1.5	2.8	......
4	1.5	2.5	1.9	3.4	6.1	5.5	4.4	1.9	1.7	1.7	2.8	......
5	1.7	2.5	1.9	3.6	5.9	5.3	4.5	2.0	1.6	1.7	2.9	......
6	1.7	2.4	2.0	4.0	5.5	4.9	4.5	2.0	1.4	1.7	2.6	......
7	1.6	2.4	2.0	4.4	5.3	4.6	4.7	2.0	1.4	1.7	2.6	......
8	1.6	2.3	2.1	5.0	5.3	4.4	4.4	2.0	1.9	1.6	2.7	......
9	1.5	2.2	2.2	4.6	5.4	4.2	4.1	2.0	2.4	1.5	2.7	......
10	1.5	2.1	2.3	4.3	5.9	4.1	3.9	2.0	2.3	1.6	2.7	......
11	1.5	2.1	2.3	4.2	6.2	4.0	3.7	2.0	2.0	1.5	3.4	......
12	1.4	2.1	2.2	4.1	6.0	4.9	3.6	2.0	1.7	1.5	3.4	......
13	1.4	2.0	2.1	4.0	5.8	5.0	3.6	2.0	1.6	1.7	5.7	......
14	1.3	2.0	2.1	3.8	5.3	4.6	3.5	2.1	1.6	1.8	8.05	......
15	1.4	2.0	2.0	3.9	5.3	4.3	3.4	2.0	1.6	2.0	....	......
16	1.4	1.9	2.0	4.2	4.9	4.3	3.3	1.9	1.6	2.4	....	......
17	1.4	1.9	2.0	4.4	4.6	4.2	3.2	1.85	1.5	2.7	....	......
18	1.4	2.0	2.0	4.3	4.4	4.0	3.1	1.8	1.5	3.0	....	......
19	1.3	2.3	2.0	4.3	4.3	3.9	3.0	1.6	1.4	2.8	....	......
20	1.3	2.5	2.0	4.4	4.2	3.8	2.9	1.6	1.4	2.7	....	......
21	1.3	2.4	2.0	4.8	4.2	3.8	2.8	1.6	1.4	2.3	....	......
22	1.4	2.3	2.0	5.85	4.1	3.8	2.7	1.6	1.4	2.2	....	......
23	1.5	2.3	2.0	5.8	4.2	3.8	2.7	1.6	1.4	2.1	....	......
24	1.8	2.2	2.0	5.6	4.2	3.9	2.6	1.5	1.4	2.0	....	......
25	2.3	2.2	2.1	5.3	4.3	4.1	2.5	1.5	1.5	1.8	....	......
26	2.4	2.1	2.2	5.0	5.4	4.4	2.5	1.6	1.8	6.5	....	......
27	2.4	2.1	2.3	4.9	5.5	4.3	2.4	1.7	1.8	6.0	....	2.2
28	2.3	2.1	2.4	4.9	5.2	4.2	2.3	1.7	1.6	5.0	....	2.2
29	2.3	....	2.5	5.3	4.9	3.9	2.3	1.8	1.5	4.3	....	2.1
30	2.2	....	2.7	5.6	4.8	3.7	2.3	1.8	1.4	3.8	....	2.1
31	2.3	....	3.4	....	4.7	....	2.3	1.8	....	3.5	....	2.1

Rating table for Wenatchee River at Cashmere, Wash., for 1905–6.

gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	550	2.00	1,360	3.00	2,450	4.00	3,800	6.00	6,900
1.10	615	2.10	1,460	3.10	2,580	4.20	4,100	6.20	7,240
1.20	685	2.20	1,560	3.20	2,710	4.40	4,400	6.40	7,580
1.30	755	2.30	1,665	3.30	2,840	4.60	4,700	6.60	7,920
1.40	830	2.40	1,770	3.40	2,970	4.80	5,000	6.80	8,260
1.50	910	2.50	1,875	3.50	3,100	5.00	5,300	7.00	8,600
1.60	990	2.60	1,985	3.60	3,240	5.20	5,620	8.00	10,400
1.70	1,075	2.70	2,095	3.70	3,380	5.40	5,940		
1.80	1,165	2.80	2,210	3.80	3,520	5.60	6,260		
1.90	1,260	2.90	2,330	3.90	3,660	5.80	6,580		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906 and is well defined between gage heights 1.5 feet and 3.9 feet.

Monthly discharge of Wenatchee River at Cashmere, Wash., for 1906.

[Drainage area, 1,190 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,770	755	1,060	65,200	0.891	1.03
February	1,980	1,260	1,910	106,000	1.61	1.68
March	2,970	1,260	1,520	93,500	1.28	1.48
April	6,660	2,840	4,540	270,000	3.82	4.26
May	7,410	3,950	5,600	344,000	4.71	5.43
June	6,100	3,380	4,310	256,000	3.62	4.04
July	4,850	1,660	2,920	180,000	2.45	2.82
August	1,560	910	1,220	75,000	1.03	1.19
September	1,770	830	1,030	61,300	.866	.97
October	7,750	830	2,060	127,000	1.73	1.99
November 1-14	10,500	1,980	3,210	89,100	2.70	1.41
December 27-31	1,560	1,460	1,500	14,900	1.26	.23
The period				1,680,000		

NOTE.—Values are rated as follows: January to March and July to November, excellent; April to June, good.

YAKIMA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Yakima River rises in Lake Keechelus, near the crest of the eastern slope of the Cascade Mountains, in Washington, and flows southeast into the Columbia River at Kennewick. The headwaters of this stream are fed by numerous tributaries draining rough mountainous areas of heavy timber lands. It is fed near its source by Kachess River, which heads in Lake Kachess, and by Clealum River, which flows through Lake Clealum. Throughout the arid portion of this drainage area the country is timberless and rolling except in the immediate valleys of the streams. The annual rainfall varies from 100 inches at the crest of the Cascades to 10 inches near the mouth of the river. The entire summer flow of the Yakima and also that of its principal tributary, Naches River, is diverted for the irrigation of lands which have reached a high stage of development, rivaled only by the orange lands of southern California.

Gaging stations are maintained as follows:

Yakima River near Martin, Clealum, Umtanum, Yakima, Prosser, Kiona, and Richland, Wash.; Kachess River near Easton, Wash.; Clealum River near Roslyn; Nachez River near Nile and North Yakima; Bumping River near Nile; and Tieton River near Natchez (two stations). Gages for determining fluctuations of water level are maintained in Lakes Keechelus, Kachess, and Clealum.

YAKIMA RIVER NEAR MARTIN, WASH.

This station was established October 18, 1903. It is 1,000 feet below the outlet of Lake Keechelus, 800 feet below the dam of the Cascade Lumber Company, and 4 miles northwest of Martin, Wash. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 43, where are given also references to publications that contain data for previous years.

Discharge measurements of Yakima River near Martin, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 18	J. C. Stevens	113	191	7.04	194
May 2	W. C. Muldrow	120	394	8.74	983
July 17	do	108	186	6.90	169
August 11	do	105	133	6.43	68
August 21 [a]	J. C. Stevens	48	45	6.37	66
October 30	W. C. Muldrow	119	295	8.01	582
November 25	do	109	208	7.18	246

[a] Made 500 feet below cable.

Daily gage height, in feet, of Yakima River near Martin, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.86	7.40	7.26	7.45	8.79	7.91	7.39	6.52	6.32	6.52	7.56	6.55
2	6.82	7.32	7.22	7.50	8.75	7.90	7.39	6.52	6.31	6.54	7.29	6.53
3	6.80	7.27	7.15	7.48	8.72	7.91	7.39	6.50	6.31	6.62	7.24	6.52
4	6.82	7.21	7.10	7.48	8.70	8.01	7.36	6.50	6.30	6.79	7.21	......
5	6.86	7.17	7.07	7.56	8.59	7.98	7.34	6.48	6.30	6.82	7.14	......
6	6.92	7.14	7.04	7.71	8.44	7.94	7.32	6.47	6.28	6.80	6.94	......
7	6.90	7.13	7.03	7.90	8.36	7.90	7.26	6.47	6.34	6.76	7.10	......
8	6.90	7.12	7.04	8.01	8.31	7.82	7.22	6.46	6.34	6.72	7.22	6.80
9	6.92	7.10	7.10	8.05	8.38	7.76	7.16	6.45	6.36	6.69	7.31	6.90
10	6.91	7.10	7.12	8.01	8.52	7.71	7.13	6.44	6.36	6.74	7.70	6.91
11	6.90	7.08	7.15	7.92	8.58	7.70	7.11	6.43	6.34	6.71	8.04	7.67
12	6.88	7.06	7.16	7.82	8.54	7.79	7.05	6.43	6.33	6.74	8.50	8.20
13	6.88	7.04	7.14	7.73	8.40	7.74	7.02	6.42	6.32	6.72	11.28	7.91
14	6.85	7.04	7.12	7.66	8.26	7.71	6.99	6.42	6.50	6.66	13.80	7.40
15	6.84	7.02	7.08	7.66	8.28	7.66	6.94	6.40	6.52	6.79	13.96	7.62
16	6.88	7.02	7.06	7.62	8.18	7.62	6.92	6.40	6.50	7.04	11.74	7.40
17	6.88	7.04	7.06	7.78	8.13	7.59	6.89	6.40	6.48	7.61	10.04	7.75
18	7.00	7.08	7.64	7.84	8.02	7.56	6.85	6.39	6.46	7.81	9.14	7.68
19	7.10	7.37	7.64	7.86	7.93	7.54	6.81	6.38	6.45	7.80	8.42	7.02
20	7.20	7.50	7.01	7.92	7.88	7.52	6.78	6.38	6.44	7.71	8.06	7.72
21	7.42	7.53	6.98	8.34	7.82	7.51	6.76	6.37	6.42	7.58	7.71	8.25
22	7.58	7.52	6.96	8.64	7.80	7.57	6.74	6.36	6.42	7.46	7.39	8.15
23	7.75	7.50	6.96	8.73	7.74	7.54	6.72	6.35	6.41	7.44	7.21	7.99
24	7.82	7.50	6.94	8.62	7.73	7.52	6.67	6.34	6.42	7.42	6.92	7.93
25	7.85	7.46	6.92	8.56	7.82	7.50	6.64	6.34	6.48	7.52	7.18	7.85
26	7.82	7.39	6.94	8.48	8.06	7.46	6.62	6.33	6.51	7.62	7.11	......
27	7.79	7.35	6.98	8.41	8.09	7.44	6.60	6.33	6.52	7.82	7.08	......
28	7.71	7.30	7.01	8.39	8.02	7.42	6.58	6.33	6.54	7.91	6.79	......
29	7.63	......	7.04	8.44	7.94	7.42	6.56	6.32	6.52	8.01	......	......
30	7.55	......	7.11	8.60	8.00	7.40	6.55	6.32	6.52	7.78	6.56	......
31	7.46	......	7.28	......	7.97	......	6.54	6.32	......	7.62	......	8.40

NOTE.—Water was entirely shut off at the lake November 29, December 4 to 7, and December 26 to 30, and for partial days at other times in December. Gage heights November 12 to 17 were computed by plotting several readings a day and taking the mean from the curve.

Rating table for Yakima River near Martin, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.20	42	7.00	180	7.80	470	8.60	890	9.80	1,730
6.30	54	7.10	207	7.90	515	8.70	950	10.00	1,900
6.40	66	7.20	237	8.00	560	8.80	1,010	11.00	2,800
6.50	80	7.30	270	8.10	610	8.90	1,075	12.00	3,850
6.60	96	7.40	306	8.20	660	9.00	1,140	13.00	5,000
6.70	114	7.50	345	8.30	715	9.20	1,275	14.00	6,200
6.80	134	7.60	385	8.40	770	9.40	1,415		
6.96	156	7.70	425	8.50	830	9.60	1,570		

NOTE.—The above table is apnlicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906, and is well defined between gage heights 6.2 feet and 9.0 feet.

Monthly discharge of Yakima River near Martin, Wash., for 1906.

[Drainage area, 56 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	492	134	250	15,400	4.46	5.14
February	357	185	255	14,200	4.55	4.74
March	263	161	200	12,300	3.57	4.12
April	968	326	581	34,600	10.38	11.58
May	1,000	438	682	41,900	12.18	14.04
June	565	306	416	24,800	7.43	8.29
July	302	86	177	10,900	3.16	3.64
August	83	56	67.3	4,140	1.20	1.38
September	86	52	68.9	4,100	1.23	1.37
October	565	83	265	16,300	4.73	5.45
November	6,150	0	979	58,300	17.48	19.51
December	770	0	272	16,700	4.86	5.60
The year	6,150	0	351	254,000	6.27	84.86

NOTE.—Values are rated as follows: January to October, excellent; November and December, fair.

YAKIMA RIVER AT CLEALUM, WASH.

This station was established August 25, 1906. It is located at the highway bridge just above the town of Clealum. It is below the principal tributaries which drain the upper portion of its basin, and shows the water supply available for the Kittitas Valley.

The channel is straight for about 300 feet above and below the station. The current is swift. The right bank is low and liable to overflow; the left is high and rocky; both banks are wooded. The bed of the stream is of cobblestones and gravel and not likely to change except during high floods. There is one channel at all stages.

Measurements are made from the bridge. The initial point for soundings is the center of the downstream pier on the right bank.

A chain gage is fastened to the bridge and is read by T. J. Denny. The bench mark is a spike in a 30-inch cottonwood tree, 30 feet downstream from the right-bank pier; elevation, 8.80 feet above the datum of the gage.

Discharge measurements of Yakima River at Clealum, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 24	J. C. Stevens	190	225	2.27	483
September 25	W. C. Muldrow	190	226	2.20	470
October 31	do	209	546	3.92	2,230

Daily gage height, in feet, of Yakima River at Clealum, Wash., for 1906.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.30	2.28	3.62	6.80	17		2.30	2.80		3.78
2		2.30	2.25	3.48	6.70	18		2.28	3.05		3.80
3		2.30	2.25	3.38	6.62	19		2.25	3.20		3.80
4		2.28	2.32	3.28	6.50	20		2.25	3.20		4.10
3		2.25	2.40	3.02	6.50	21		2.22	3.12		4.60
6		2.25	2.40	2.88	6.50	22		2.20	3.00		4.90
7		2.25	2.40	2.95	6.50	23		2.20	3.00		4.80
8		2.25	2.40	3.10	6.55	24	2.25	2.20	3.00		4.70
9		2.28	2.40	3.08	5.28	25	2.30	2.25	2.95		4.60
10		2.28	2.40	3.30	4.05	26	2.30	2.30	5.50		4.25
11		2.25	2.40	3.85	4.00	27	2.30	2.30	6.00		4.05
12		2.25	2.40	4.22	4.20	28	2.30	2.30	5.25	7.15	4.00
13		2.25	2.40	6.68	4.35	29	2.30	2.30	4.60	7.00	3.95
14		2.30	2.40		4.20	30	2.30	2.30	4.15	6.82	3.90
15		2.30	2.45		3.95	31	2.30		3.80		2.75
16		2.30	2.55		4.05						

Rating table for Yakima River at Clealum, Wash., from August 24 to October 25, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	330	2.30	505	2.60	730	2.90	1,000	3.20	1,310
2.10	380	2.40	575	2.70	815	3.00	1,100		
2.20	440	2.50	650	2.80	905	3.10	1,200		

NOTE.—The above table is based on 3 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Yakima River at Clealum, Wash., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
August 24-31	505	472	501	7,950
September	505	440	484	28,800
October 1-25	1,310	472	770	38,200
The period	....	....	....	75,000

NOTE.—Values are good.

YAKIMA RIVER AT UMTANUM, WASH.

This station was established August 25, 1906. It is located in a canyon about 100 yards from the railroad tracks and opposite the station at Umtanum, about 6 miles above Roza, on the Northern Pacific Railroad. The station is below Kittitas Valley and above Selah and Yakima valleys.

The channel is straight for about 200 feet above and below the station. There is a riffle control about 300 feet below. The right bank is low and liable to overflow to the railroad embankment; the left is high and rocky. The right half of the bed of the stream is composed of gravel and cobblestones; the left is of solid rock. There is one channel at all stages.

Discharge measurements are made from a cable and car. There is a stay line 75 feet upstream from the cable. The initial point for soundings is the face of a small cottonwood tree 10 inches in diameter, 15 feet upstream from the gage, on the right bank, about 25 feet from the water's edge.

The gage, which was read during the season by B. F. Cummings, is a 2 by 4 inch timber fastened in a vertical position on the right bank, back of the section house. The bench mark is a mark on a bowlder 100 feet west of the section house and 40 feet north of the Northern Pacific track, opposite the gage; elevation, 16.30 feet above the datum of the gage.

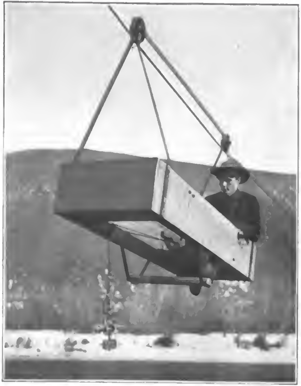
The following measurement was made August 25, 1906:

Width, 230 feet; area, 414 feet; gage height, 3.07 feet; discharge, 365 second-feet.

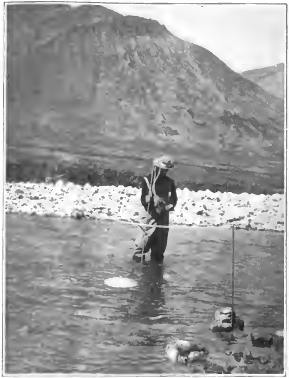
Daily gage height, in feet, of Yakima River at Umtanum, Wash., for 1906.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	2.98	3.20	4.55	5.88	17	....	3.08	3.55	....	4.56
2	....	2.98	3.22	4.46	5.72	18	....	3.08	3.70	....	4.61
3	....	3.00	3.25	4.34	5.50	19	....	3.10	4.00	....	4.66
4	....	3.00	3.28	4.30	5.18	20	....	3.10	4.10	....	4.80
5	....	2.99	3.31	4.12	5.05	21	....	3.06	4.08	....	5.00
6	....	2.98	3.38	4.08	4.88	22	....	3.06	4.05	....	5.06
7	....	2.98	3.48	4.00	4.68	23	....	3.06	4.00	....	5.04
8	....	2.98	3.45	4.08	4.52	24	....	3.10	3.96	....	5.11
9	....	2.98	3.45	4.15	4.56	25	3.07	3.12	3.88	....	5.16
10	....	2.97	3.42	4.32	4.70	26	3.00	3.16	4.88	....	5.13
11	....	2.98	3.40	4.45	4.70	27	3.00	3.20	6.40	....	5.00
12	....	3.04	3.40	5.18	4.71	28	3.03	3.24	6.00	6.20	4.92
13	....	3.06	3.40	6.78	4.69	29	3.00	3.22	5.30	6.01	4.82
14	....	3.10	3.42	9.66	4.65	30	3.00	3.20	4.95	5.94	4.60
15	....	3.10	3.45	....	4.62	31	2.95	....	4.75	....	4.34
16	....	3.07	3.45	14.2	4.59						

NOTE.—The upper portion of the gage was washed away November 15, so that no readings could be obtained until the 28th. The gage height of November 16 is the maximum.



A. CABLE STATION YAKIMA RIVER NEAR UNION GAP, WASHINGTON.



B. DISCHARGE MEASUREMENT BY WADING.

YAKIMA RIVER NEAR YAKIMA, WASH.

The station was originally established August 14, 1893, at the county bridge at Union Gap (Pl. III, *A*), 2 miles below Yakima, Wash. In August, 1895, a cable and new gage were installed about 1,000 feet below the bridge, and about 3 miles above the intake of the Sunnyside Canal. The station is of value, as it is the only point near the large irrigated areas above and below which is unaffected by the diversion of water. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 46, where are given also references to publications that contain data for previous years.

Discharge measurements of Yakima River near Yakima, Wash., in 1905–1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	W. J. Lightfoot	236	1,340	6.19	3,920
September 2	W. C. Muldrow	230	753	3.64	780
October 26	.....do	240	1,250	5.60	3,579
November 18	Sawyer and Muldrow	238	960	4.32	1,600
1906.					
March 26	J. C. Stevens	240	1,190	5.29	2,900
April 30	W. C. Muldrow	340	1,800	7.62	9,790
July 9	.....do	241	1,100	5.14	2,849
August 3	.....do	232	687	3.52	748
September 29	Stevens and Grover	234	723	3.60	790
October 27	Muldrow and McGlashan	249	1,620	7.29	6,779
December 29	W. C. Muldrow	242	1,810	5.68	4,049
1907.					
February 20	W. C. Muldrow	300	2,190	7.03	7,749
February 22	.....do	300	2,410	7.69	9,770

Daily gage height, in feet, of Yakima River near Yakima, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.1	5.85	5.9	7.6	8.0	6.2	5.7	3.6	3.4	3.55	5.4	5.7
2	4.1	5.9	5.8	7.4	8.1	6.2	5.9	3.5	3.4	3.5	5.25	5.6
3	4.1	5.9	5.6	7.2	8.2	6.6	5.1	3.5	3.35	3.6	5.15	5.5
4	4.05	6.9	5.4	7.1	8.1	6.8	5.0	3.5	3.35	3.65	5.0	5.3
5	4.1	6.0	5.3	7.3	8.0	6.9	5.1	3.4	3.35	3.8	4.8	5.2
6	4.15	5.9	5.2	7.9	8.0	6.6	5.2	3.4	3.35	3.9	5.0	5.15
7	4.2	5.8	5.2	8.1	7.9	6.3	5.3	3.45	3.4	3.9	5.3	5.15
8	4.2	5.6	5.6	8.2	7.6	6.1	5.2	3.45	3.4	3.9	5.3	5.6
9	4.2	5.5	5.8	8.2	7.4	6.0	5.1	3.45	3.4	3.9	5.4	5.5
10	4.2	5.45	5.8	7.9	7.4	6.9	5.9	3.45	3.45	3.85	5.4	5.5
11	4.2	5.3	5.7	7.7	7.8	5.9	5.0	3.45	3.4	3.9	6.2	5.55
12	4.2	5.3	5.7	7.4	7.6	5.9	4.9	3.55	3.4	3.9	6.9	5.4
13	4.2	5.1	5.6	7.3	7.6	6.0	4.8	3.45	3.4	3.9	10.84	5.3
14	4.1	5.9	5.5	7.1	7.4	6.1	4.9	3.5	3.5	3.9	13.36	5.3
15	4.1	5.9	5.5	7.9	7.9	6.0	4.9	3.55	3.55	3.9	15.68	5.2
16	4.1	5.9	5.4	7.2	6.9	6.9	4.6	3.5	3.55	4.9	14.18	5.2
17	4.1	5.05	5.4	7.4	6.6	5.9	4.5	3.5	3.55	4.3	11.94	5.1
18	4.1	5.2	5.3	7.3	6.4	5.9	4.5	3.45	3.5	4.5	10.2	5.9
19	4.9	5.8	5.2	7.3	6.2	5.8	4.5	3.45	3.5	4.6	8.9	5.9
20	4.05	6.0	5.2	7.4	6.1	5.8	4.4	3.45	3.5	4.6	8.6	6.3
21	4.1	6.0	5.15	7.7	6.0	5.7	4.4	3.45	3.5	4.6	8.0	6.5
22	4.3	6.1	5.1	7.9	6.9	5.6	4.2	3.4	3.5	4.55	7.4	6.5
23	4.4	6.2	5.1	8.3	5.9	5.4	4.1	3.35	3.55	4.5	7.1	6.7
24	4.7	6.2	5.1	8.6	5.9	5.4	4.9	3.4	3.55	4.5	6.9	6.6
25	5.1	6.2	5.1	8.1	5.9	5.5	4.9	3.4	3.5	4.55	6.7	6.5
26	5.3	6.1	5.2	7.9	6.3	5.5	3.9	3.4	3.5	4.6	6.3	6.4
27	5.3	6.0	5.6	7.5	7.9	5.5	3.9	3.35	3.55	7.3	6.1	6.3
28	5.5	6.0	5.8	7.5	6.9	5.4	3.8	3.35	3.55	7.3	6.9	6.0
29	5.5	......	6.9	7.6	6.8	5.3	3.8	3.4	3.55	6.9	5.9	5.9
30	5.55	......	6.3	7.8	6.7	5.3	3.7	3.4	3.5	6.5	5.9	5.7
31	5.9	......	6.4	......	6.6	......	3.7	3.4	......	6.9	......	5.6

NOTE.—Gage heights November 12 to 17 were found by plotting several readings a day and taking the mean from the curve.

Rating tables for Yakima River near Yakima, Wash.

JANUARY 1, 1904, TO JUNE 4, 1905.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.80	920	4.70	1,800	5.60	3,070	6.50	5,035	7.80	9,170
3.90	1,000	4.80	1,920	5.70	3,240	6.60	5,295	8.00	9,930
4.00	1,090	4.90	2,045	5.80	3,420	6.70	5,565	8.20	10,740
4.10	1,180	5.00	2,180	5.90	3,615	6.80	5,835	8.40	11,600
4.20	1,280	5.10	2,315	6.00	3,830	6.90	6,115	8.60	12,480
4.30	1,380	5.20	2,455	6.10	4,055	7.00	6,405	8.80	13,360
4.40	1,480	5.30	2,600	6.20	4,285	7.20	7,025	9.00	14,240
4.50	1,580	5.40	2,750	6.30	4,525	7.40	7,720	9.20	15,120
4.60	1,690	5.50	2,910	6.40	4,775	7.60	8,440		

JUNE 5, 1905, TO DECEMBER 31, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
3.00	460	4.10	1,290	5.20	2,840	6.60	6,220	8.80	14,670
3.10	500	4.20	1,405	5.30	3,020	6.80	6,890	9.00	15,600
3.20	550	4.30	1,520	5.40	3,210	7.00	7,590	10.00	20,800
3.30	605	4.40	1,640	5.50	3,400	7.20	8,290	11.00	26,700
3.40	665	4.50	1,760	5.60	3,600	7.40	9,010	12.00	33,200
3.50	725	4.60	1,890	5.70	3,810	7.60	9,750	13.00	40,500
3.60	795	4.70	2,030	5.80	4,030	7.80	10,510	14.00	48,600
3.70	875	4.80	2,180	5.90	4,260	8.00	11,300	15.00	57,400
3.80	965	4.90	2,340	6.00	4,500	8.20	12,100	16.00	67,000
3.90	1,070	5.00	2,500	6.20	5,030	8.40	12,930		
4.00	1,180	5.10	2,670	6.40	5,600	8.60	13,780		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-5 and is well defined.

[b] This table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1905-6 and is well defined between gage heights 3.5 feet and 7.7 feet. The extension of the table is based on a discharge for the maximum gage height of 1906 computed from a measurement at Kiona.

Monthly discharge of Yakima River near Yakima, Wash., for 1905-6.

[Drainage area, 3,300 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
January	2,180	1,280	1,830	113,000	0.554	6.64
February	3,620	920	1,730	95,900	.523	.54
March	9,550	3,830	7,540	463,000	2.28	2.63
April	9,930	3,420	4,750	283,000	1.44	1.61
May	7,720	3,830	4,930	303,000	1.49	1.72
June	14,700	5,310	8,320	495,000	2.52	2.81
July	5,900	1,290	2,710	167,000	.821	.95
August	1,290	795	922	56,700	.279	.32
September	1,180	795	904	53,800	.274	.31
October	5,750	1,290	3,200	197,000	.970	1.12
November	2,670	1,520	1,880	112,000	.570	.64
December	2,100	1,400	1,700	105,000	.515	.59
The year	14,700	795	3,370	2,440,000	1.02	13.86
1906.						
January	4,260	1,180	1,820	112,000	0.552	0.64
February	5,030	2,500	3,880	215,000	1.18	1.23
March	5,600	2,670	3,480	214,000	1.05	1.21
April	13,800	7,590	9,900	589,000	3.00	3.35
May	12,100	4,260	7,910	486,000	2.40	2.77
June	7,240	3,020	4,410	262,000	1.34	1.50
July	3,810	965	1,970	121,000	.600	.69
August	795	635	694	42,700	.210	.24
September	760	635	705	42,000	.212	.24
October	8,650	725	2,220	136,000	.673	.78
November	63,900	2,180	12,400	738,000	3.76	4.20
December	6,550	2,500	3,920	241,000	1.19	1.37
The year	63,900	635	4,440	3,200,000	1.35	18.20

NOTE.—Values are rated as follows: 1905 and January to June, 1906, excellent; July to December, 1906, fair.

YAKIMA RIVER AT PROSSER, WASH.

This station was established February 8, 1906, to replace the old station at the highway bridge below Prosser Falls, described in Water-Supply Paper No. 178, page 48. It was abandoned October 12, 1906, as it was found unsuited for low-water measurements and as the flow was controlled by dams above. It was located 1½ miles below the town of Prosser, about 1¼ miles below the county bridge across Yakima River and the power plant of the Prosser Falls Land and Power Company, and about 2,000 feet from the Northern Pacific Railroad tracks.

The channel is straight, and the current fairly swift except at low stages. The banks are of earth, intermingled with basaltic bowlders; the right bank is high; the left is low and liable to overflow at extreme high water. The bed of the stream is composed of massive bowlders and angular cobblestones. There is one channel at all stages.

Discharge measurements were made from a cable and car, which was removed when the station was abandoned. The initial point for soundings is a cross on a large bowlder, 2 feet back of the shear legs on the left bank.

A wooden inclined gage, which was read by G. W. Booth, was located on the right bank, 80 feet upstream from the shear legs. The bench mark is the top of a copper plug in a large bowlder about 40 feet downstream from the gage; elevation, 18.44 feet above the datum of the gage and 613.44 feet above sea level.

Discharge measurements of Yakima River at Prosser, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 8	W. C. Muldrow	310	1,720	7.20	4,160
February 23	do	312	1,990	8.04	5,450
March 24	J. C. Stevens	303	1,610	6.84	3,200
May 17	W. C. Muldrow	316	2,060	8.25	5,900
July 12	do	291	1,160	5.48	1,470
August 18	J. C. Stevens			3.00	[a] 100
November 17 [b]	D. C. Henny	662	7,470		62,800

[a] Estimated.

[b] Measured by floats from new highway bridge above the dam.

Daily gage height, in feet, of Yakima River at Prosser, Wash., for 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	7.8	7.4	9.5	9.7	7.8	5.7	3.4	2.9	2.9
2	7.8	7.2	9.7	10.1	7.7	5.6	3.4	3.0	3.1
3	7.7	7.2	9.4	10.1	7.3	5.6	3.3	2.9	3.3
4	7.5	7.2	9.3	10.2	7.8	5.5	3.2	2.9	3.4
5	7.5	7.1	9.3	10.2	8.1	5.6	3.2	2.9	3.6
0	7.5	7.0	9.6	9.9	8.3	5.7	3.2	2.7	3.4
7	7.3	7.0	10.1	9.5	7.8	5.7	3.3	2.9	3.0
8	7.2	7.1	10.5	9.3	7.7	5.8	3.2	2.9	3.1
9	7.1	7.2	10.5	9.0	7.3	5.8	2.9	3.0	3.5
10	7.0	7.4	10.4	9.1	7.0	5.7	3.1	3.0	3.8
11	7.0	7.3	10.1	9.3	6.8	5.5	2.8	2.9	3.8
12	6.9	7.1	9.8	9.3	7.2	5.4	3.2	2.9	3.8
13	6.8	7.0	9.4	9.0	7.4	5.3	2.6	3.0	....
14	6.7	7.2	9.2	8.8	7.5	5.2	3.0	3.0	....
15	6.6	7.4	9.2	8.6	7.4	5.2	3.0	3.0	....
16	6.6	7.3	9.1	8.4	7.3	5.1	3.0	3.0	....
17	6.5	7.3	9.2	8.2	7.1	5.0	3.0	3.1	....
18	6.6	7.2	9.3	7.6	7.0	4.9	3.0	3.2	....
19	6.8	7.1	9.3	7.0	7.0	4.8	2.6	3.2	....
20	8.0	6.9	9.2	6.7	6.9	4.7	3.0	3.2	....
21	8.3	6.9	9.2	7.3	6.7	4.6	2.9	3.2	....
22	8.2	6.8	9.8	7.0	6.5	4.5	3.1	3.0	....
23	8.0	6.8	10.5	7.0	6.3	4.4	2.9	2.9	....
24	7.9	6.8	10.7	7.0	6.2	4.2	3.0	3.0	....
25	7.8	6.9	10.5	7.2	6.2	4.1	2.8	3.0	....
26	7.7	7.0	9.9	7.4	6.2	4.0	2.6	3.1	....
27	7.7	7.2	9.6	8.4	6.1	3.9	3.0	3.2	....
28	7.6	7.4	9.3	8.5	6.1	3.8	3.1	3.0	....
29	....	7.8	9.2	8.4	6.0	3.7	3.0	2.8	....
30	....	8.0	9.3	8.0	5.8	3.6	2.6	2.6	....
31	....	8.3	....	7.8	....	3.5	2.6	....	....

Rating table for Yakima River at Prosser, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.60	40	3.80	345	5.00	1,060	6.40	2,580	8.80	7,050
2.70	50	3.90	390	5.10	1,140	6.60	2,860	9.00	7,510
2.80	65	4.00	435	5.20	1,225	6.80	3,160	9.20	7,980
2.90	80	4.10	485	5.30	1,310	7.00	3,480	9.40	8,460
3.00	100	4.20	540	5.40	1,400	7.20	3,820	9.60	8,940
3.10	120	4.30	595	5.50	1,500	7.40	4,170	9.80	9,440
3.20	145	4.40	655	5.60	1,600	7.60	4,530	10.00	9,940
3.30	170	4.50	715	5.70	1,710	7.80	4,910	11.00	12,500
3.40	200	4.60	780	5.80	1,820	8.00	5,310		
3.50	230	4.70	845	5.90	1,940	8.20	5,730		
3.60	265	4.80	915	6.00	2,060	8.40	6,160		
3.70	305	4.90	985	6.20	2,310	8.60	6,600		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1906 and is well defined between gage heights 5 feet and 9 feet.

Monthly discharge of Yakima River at Prosser, Wash., for 1906.

[Drainage area, 5,050 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
February	5,940	2,720	4,150	230,000	0.822	0.86
March	5,940	3,160	3,860	237,000	.764	.88
April	11,700	7,740	9,130	543,000	1.81	2.02
May	10,400	3,010	6,580	405,000	1.30	1.50
June	5,940	1,820	3,600	214,000	.713	.80
July	1,820	230	1,080	66,400	.214	.25
August	200	40	106	6,520	.021	.02
September	145	40	98.0	5,830	.019	.02
October 1-12	345	80	210	5,000	.042	.02
The period	....	....	....	1,710,000	....	....

NOTE.—Values are rated as follows: February to June, excellent; July, good; August to October, fair.

YAKIMA RIVER AT KIONA, WASH.

This station was established August 20, 1895. It is located at the highway bridge on the county road about 1,800 feet northwest of the Northern Pacific Railway station at Kiona, Wash. It is about 23 miles above the mouth of the river. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 49, where are given also references to publications that contain data for previous years.

The staff gage, installed December 23, 1905, was read from January 1 to March 22, 1906. Subsequent to that date the wire gage was used. These gages are referred to the following bench marks: (1) A standard U. S. Geological Survey iron bench-mark post near the Northern Pacific Railway station; elevation, 61.35 feet above the datum of the gage and 514.79 feet above mean sea level. (2) A standard U. S. Geological Survey iron bench mark in northeast corner of H. A. Shandy's lot near right approach of highway bridge; elevation, 18.99 feet above gage datum. These elevations were checked during 1906.

Discharge measurements of Yakima River at Kiona, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 21[a]	W. C. Muldrow	265	1,580	7.14	5,480
March 23	J. C. Stevens	275	1,200	5.72	2,870
May 8	W. C. Muldrow	301	1,850	8.09	7,700
July 11	do	217	925	4.64	1,560
July 30[b]	do	67	82	2.99	309
August 18[b]	Muldrow and Stevens	60	58	2.52	150
October 13[b]	W. C. Muldrow	75	96	3.07	285
November 17[c]	D. C. Henny	1,600	8,400	19.52	61,600
November 19[c]	W. C. Muldrow		4,250	15.00	31,700
December 18	do	265	1,310	6.14	3,570

[a] Mean of two measurements. [b] Measured by wading. [c] Measured by floats.

Daily gage height, in feet, of Yakima River at Kiona, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.55	6.35	6.35	8.5	8.7	6.8	4.8	2.8	2.45	2.75	5.8	6.55
2	4.55	6.45	6.25	8.8	9.2	6.7	4.8	2.8	2.4	2.8	5.7	6.55
3	4.55	6.65	6.15	8.6	9.4	6.5	4.7	2.7	2.45	2.85	5.5	6.55
4	4.55	6.55	6.05	8.45	9.45	6.7	4.7	2.7	2.4	2.9	5.4	6.6
5	4.6	6.45	6.05	8.4	9.4	6.9	4.7	2.7	2.4	2.95	5.3	6.7
6	4.6	6.35	6.0	8.8	9.3	7.2	4.7	2.7	2.45	3.0	5.2	6.7
7	4.6	6.25	5.95	9.3	8.8	6.9	4.7	2.7	2.45	3.0	5.2	6.7
8	4.6	6.15	5.95	9.7	8.5	6.8	4.6	2.65	2.5	3.0	5.5	6.7
9	4.65	6.15	6.45	9.8	8.3	6.4	4.6	2.6	2.45	3.1	5.3	6.7
10	4.65	6.05	6.55	9.75	8.3	6.3	4.6	2.6	2.4	3.2	5.7	6.7
11	4.65	5.95	6.65	9.35	8.3	6.2	4.45	2.6	2.35	3.2	6.2	6.65
12	4.65	5.9	6.45	9.05	8.4	6.1	4.35	2.55	2.4	3.1	6.82	6.6
13	4.6	5.75	6.25	8.6	8.2	6.3	4.25	2.6	2.5	3.05	7.90	6.5
14	4.6	5.6	6.05	9.4	7.9	6.3	4.2	2.6	2.55	3.05	10.4	6.4
15	4.6	5.55	6.25	9.2	7.6	6.3	4.1	2.5	2.55	3.05	13.02	6.3
16	4.55	5.5	6.45	8.1	7.55	6.2	4.0	2.45	2.6	3.1	17.34	6.3
17	4.55	5.45	6.35	8.3	7.25	6.2	3.9	2.5	2.6	3.1	19.78	6.2
18	4.55	5.45	6.25	8.4	6.95	6.1	3.8	2.45	2.55	3.3	17.55	6.15
19	4.5	5.65	6.05	8.4	6.55	6.0	3.7	2.5	2.5	3.8	15.62	6.2
20	4.45	6.65	5.85	8.45	6.3	5.8	3.6	2.45	2.55	4.1	12.84	6.3

Daily gage height, in feet, of Yakima River at Kiona, Wash., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	4.4	7.35	5.9	8.5	6.2	5.7	3.5	2.5	2.6	4.3	10.62	6.3
22	4.5	7.2	5.95	8.7	6.05	5.5	3.3	2.45	2.6	4.3	9.9	6.9
23	4.65	7.1	5.95	9.6	6.0	5.4	3.2	2.5	2.65	4.3	8.9	8.3
24	4.85	7.0	5.85	9.9	5.9	5.2	3.1	2.6	2.65	4.2	8.5	8.3
25	4.75	6.75	5.9	9.7	5.8	5.2	3.1	2.55	2.68	4.2	8.2	8.2
26	5.75	6.65	5.9	9.2	6.2	5.2	3.0	2.55	2.7	4.1	8.0	8.05
27	5.85	6.45	6.0	9.0	7.25	5.1	2.8	2.55	2.7	4.3	7.7	8.05
28	6.25	6.45	6.35	8.6	7.5	6.0	2.8	2.6	2.7	7.2	7.5	7.7
29	6.3	....	6.55	8.4	7.4	4.9	2.8	2.55	2.7	7.0	7.1	7.6
30	6.35	....	6.9	8.5	7.1	4.8	2.75	2.5	2.7	6.7	6.9	7.3
31	6.25	....	7.3	....	7.0	....	2.8	2.4	....	6.5	....	7.3

NOTE.—The gage heights from November 15 to 21 were found by plotting several readings a day, and taking the mean from the curve.

Rating table for Yakima River at Kiona, Wash., from October 1, 1905, to December 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	90	3.60	620	4.90	1,780	6.40	3,990	9.00	9,590
2.40	120	3.70	690	5.00	1,900	6.60	4,350	10.00	12,100
2.50	150	3.80	760	5.10	2,020	6.80	4,740	11.00	14,950
2.60	180	3.90	835	5.20	2,150	7.00	5,140	12.00	18,150
2.70	210	4.00	910	5.30	2,280	7.20	5,550	13.00	21,900
2.80	245	4.10	990	5.40	2,420	7.40	5,970	14.00	26,350
2.90	280	4.20	1,070	5.50	2,560	7.60	6,390	15.00	31,700
3.00	315	4.30	1,160	5.60	2,700	7.80	6,830	16.00	37,600
3.10	355	4.40	1,250	5.70	2,850	8.00	7,270	17.00	44,000
3.20	400	4.50	1,350	5.80	3,000	8.20	7,710	18.00	50,800
3.30	450	4.60	1,450	5.90	3,160	8.40	8,170	19.00	57,800
3.40	500	4.70	1,560	6.00	3,320	8.60	8,630	20.00	65,100
3.50	555	4.80	1,670	6.20	3,650	8.80	9,110		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1897-1906 and is well defined.

Monthly discharge of Yakima River at Kiona, Wash., for 1905–6.

[Drainage area, 5,230 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
October[a]	4,740	690	2,470	152,000	0.473	0.56
November[a]	2,560	1,560	1,860	111,000	.356	.44
December[a]	1,900	1,450	1,710	105,000	.327	.44
1906.						
January	3,900	1,250	1,850	114,000	.354	.41
February	5,860	2,490	3,840	213,000	.734	.76
March	5,760	3,080	3,710	228,000	.709	.82
April	11,800	7,490	9,400	559,000	1.80	2.01
May	10,700	3,000	6,620	407,000	1.27	1.46
June	5,550	1,670	3,440	205,000	.658	.73
July	1,670	228	923	56,800	.176	.20
August	245	120	172	10,600	.033	.04
September	210	105	162	9,640	.031	.03
October	5,550	228	1,120	68,900	.214	.25
November	63,500	2,150	12,400	738,000	2.37	2.64
December	7,940	3,560	5,010	308,000	.958	1.10
The year	63,500	105	4,050	2,920,000	.776	10.45

[a] These values supersede those published in Water-Supply Paper No. 178, which were in error. The published gage heights for 1905 were in error as follows: October 21 to November 9, 0.7 foot too high; November 10 to 29, 0.2 foot too high; November 30 to December 19, 0.3 foot too high, and from December 19 to 23, 0.35 foot too high.

NOTE.—Values for 1905 and 1906 are rated as good.

YAKIMA RIVER NEAR RICHLAND, WASH.

This station was established July 28, 1906, for the purpose of determining the amount of water wasted into Columbia River. It is maintained only during the irrigating season. It is located at Yakima Ferry, near the mouth of Yakima River, and below the headgate of the Amon Canal, the last diversion.

The channel is straight, the banks are high and clean. The bed of the stream is composed of gravel and bowlders.

Measurements are made by wading at any convenient place near the gage.

The gage, which was read during the season by J. E. See, is a 1 by 6 inch board bolted to a large bowlder in midstream, 500 feet below the ferry. The bench mark is a cross, marked B. M., on a large, round bowlder in the channel, at right angles to the direction of current from the old cribworks on the right bank, where an old water lift wheel was located; elevation, 5.05 feet above the datum of the gage.

Discharge measurements of Yakima River near Richland, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 28	W. C. Muldrow	89	122	1.46	175
August 17	J. C. Stevens	16	12	.63	9.4
October 13	W. C. Muldrow	100	140	1.55	195

Daily gage height, in feet, of Yakima River near Richland, Wash., for 1906.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1		1.25	0.6	0.8	12		0.7	0.6	1.6	23		0.6	0.6	
2		1.15	.6	.85	13		.7	.6	1.55	24		.6	.6	
3		1.1	.6	1.0	14		.65	.6	1.52	25		.6	.75	
4		1.5	.6	1.25	15		.65	.6	1.6	26		.6	.8	
5		1.0	.6	1.2	16		.65	.6	1.7	27		.6	.88	
6		0.9	.6	1.35	17		.65	.6	1.75	28	1.5	.6	.8	
7		.8	.6	1.3	18		.6	.6	1.78	29	1.4	.6	.8	
8		.75	.6	1.38	19		.6	.6	1.9	30	1.35	.6	.8	
9		.7	.6	1.28	20		.6	.6	2.8	31	1.25	.6		
10		.75	.6	1.5	21		.6	.6						
11		.7	.6	1.55	22		.6	.6						

Rating table for Yakima River near Richland, Wash., from July 28, 1906, to October 19, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	8	0.90	31	1.20	87	1.50	185	1.80	340
0.70	13	1.00	46	1.30	114	1.60	235	1.90	400
0.80	21	1.10	65	1.40	145	1.70	280		

NOTE.—The above table is based on 3 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Yakima River near Richland, Wash., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
July (28-31)	185	100	140	1,110
August	185	8	24.6	1,520
September	29	8	10.7	637
October (1-19)	400	21	178	6,710
The period				9,970

NOTE.—Values are rated as fair.

LAKE KEECHELUS NEAR MARTIN, WASH.

This station was established January 12, 1906, to obtain the fluctuations of the lake surface and the amount of stored water. It is located at the foot of the lake, 4 miles northeast of Martin, Wash., on the State road over Snoqualmie Pass.

All gage heights for 1906 refer to the level of the sill of the outlet tunnel of the dam, which is 2,457.00 feet above sea level. The bench mark is a spike in the root of a stump on the right bank of the outlet near the abutment of the dam; elevation, 16.05 feet above the datum of the gage and 2,473.05 above sea level.

Daily gage height, in feet, of Lake Keechelus near Martin, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.72	1.48	1.73	3.17	2.47	1.73	0.82	0.40	0.44	2.22	3.12
2		1.62	1.41	1.86	3.57	2.40	1.73	.80	.38	.46	2.06	3.31
3		1.53	1.33	1.84	3.54	2.40	1.73	.78	.37	.54	2.02	3.41
4		1.43	1.28	1.84	3.50	2.63	1.70	.78	.36	.91	1.99	3.59
5		1.35	1.25	1.91	3.39	2.58	1.68	.76	.35	.93	1.94	3.55
6		1.32	1.20	2.10	3.16	2.51	1.64	.75	.32	.92	2.08	4.12
7		1.31	1.16	2.37	3.02	2.44	1.58	.75	.36	.88	2.22	4.39
8		1.30	1.16	2.53	2.96	2.34	1.52	.74	.36	.94	2.44	4.82
9		1.28	1.22	2.58	3.03	2.24	1.47	.73	.36	.99	2.64	5.01
10		1.26	1.30	2.53	3.25	2.19	1.44	.72	.36	1.00	3.16	5.09
11		1.24	1.33	2.42	3.30	2.15	1.43	.70	.33	.97	3.70	5.20
12	0.86	1.22	1.36	2.30	3.28	2.22	1.37	.70	.32	1.01	3.92	4.66
13	.85	1.20	1.34	2.16	3.09	2.17	1.34	.69	.32	1.04	5.73	4.21
14	.83	1.18	1.32	2.06	2.90	2.14	1.31	.64	.52	1.10	6.09	4.01
15	.77	1.16	1.28	2.04	2.95	2.11	1.26	.64	.54	1.32		3.93
16	.92	1.16	1.24	2.00	2.84	2.08	1.24	.63	.52	1.67		3.81
17	.94	1.17	1.24	2.25	2.73	2.03	1.21	.62	.50	2.22		4.03
18	1.00	1.20	1.18	2.32	2.56	2.00	1.17	.62	.46	2.64		4.01
19		1.70	1.18	2.34	2.43	1.96	1.13	.61	.42	2.64		4.41
20		1.84	1.13	2.46	2.36	1.94	1.10	.60	.40	2.50		4.91
21	1.46	1.87	1.10	2.76	2.30	1.94	1.06	.60	.37	2.27		4.95
22	1.57	1.86	1.08	3.04	2.28	1.99	1.04	.58	.35	2.16		4.75
23	1.77	1.84	1.08	3.07	2.21	1.96	1.02	.56	.34	2.11		4.52
24	1.84	1.84	1.04	2.98	2.17	1.92	.97	.54	.34	2.06		4.31
25	1.87	1.80	1.02	2.92	2.26	1.90	.94	.52	.40	2.17		4.29
26	2.30	1.75	1.04	2.88	2.65	1.86	.92	.50	.47	2.27		4.69
27	2.20	1.67	1.08	2.82	2.69	1.86	.90	.49	.48	2.32		5.02
28	2.14	1.58	1.11	2.80	2.62	1.83	.88	.48	.50	2.47		5.32
29	2.03		1.16	2.90	2.53	1.84	.86	.46	.48	2.67		5.63
30	1.93		1.25	3.02	2.56	1.82	.85	.43	.45	2.57	3.12	5.95
31	1.82		1.56		2.52		.84	.41		2.37		6.22

KACHESS LAKE NEAR EASTON, WASH.

This station was established September 20, 1905, in order to determine the amount of storage in Kachess Lake. The datum of the gage is the same as during 1905.

Daily gage height, in feet, of Kachess Lake, near Easton, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.25	2.2	1.95	1.7	3.6	5.6	5.4	3.25	1.35	0.55	2.45	3.85
2	1.2	2.2	1.9	1.8	3.8	5.65	5.3	3.2	1.3	.6	2.35	3.6
3	1.15	2.15	1.85	1.9	3.8	5.8	5.25	3.2	1.2	.6	2.3	3.35
4	1.2	2.15	1.8	2.0	3.8	6.0	5.2	3.15	1.1	.65	2.2	3.2
5	1.15	2.15	1.8	2.0	3.75	6.05	5.1	3.15	1.1	.65	2.2	3.0
6	1.25	2.1	1.7	2.1	3.7	6.1	5.05	3.15	1.0	.65	2.4	2.85
7	1.15	2.05	1.6	2.25	3.6	6.1	5.0	3.1	1.0	.65	2.5	2.9
8	1.15	2.05	1.6	2.5	3.5	6.05	4.9	3.1	.95	.65	2.65	2.8
9	1.2	2.0	1.6	2.65	3.5	6.0	4.8	3.05	.9	.6	2.75	2.6
10	1.15	2.0	1.6	2.7	3.6	6.0	4.7	3.0	.85	.65	3.1	2.5
11	1.1	2.05	1.6	2.7	3.8	5.95	4.6	2.9	.8	.65	3.4	2.4
12	1.1	1.95	1.6	2.6	4.0	5.95	4.5	2.85	.75	.65	3.92	2.3
13	1.15	1.9	1.6	2.6	4.1	5.9	4.45	2.75	.75	.65	5.38	2.2
14	1.15	1.9	1.6	2.6	4.2	5.9	4.35	2.7	.8	.7	8.18	2.15
15	1.15	1.8	1.55	2.6	4.4	5.85	4.25	2.65	.75	.75	9.46	2.1
16	1.1	1.7	1.55	2.65	4.6	5.85	4.2	2.55	.7	.85	9.34	2.05
17	1.1	1.7	1.55	2.7	4.7	5.75	4.1	2.5	.7	1.1	8.72	1.95
18	1.1	1.85	1.55	2.7	4.8	5.7	4.0	2.4	.7	1.25	8.1	1.9
19	1.1	1.9	1.55	2.8	5.0	5.7	3.9	2.3	.65	1.3	7.6	2.0
20	1.1	1.95	1.5	2.8	5.15	5.7	3.8	2.2	.6	1.3	7.1	2.15
21	1.15	1.9	1.5	3.0	5.25	5.75	3.7	2.1	.6	1.3	6.6	2.2
22	1.15	2.0	1.5	3.3	5.35	5.8	3.6	2.05	.6	1.3	6.2	2.25
23	1.3	1.9	1.4	3.4	5.4	5.8	3.5	2.0	.6	1.25	5.8	2.2
24	1.35	1.85	1.4	3.5	5.45	5.8	3.5	1.9	.55	1.3	5.4	2.15
25	1.45	1.95	1.5	3.5	5.45	5.8	3.4	1.9	.6	1.4	5.3	2.1
26	1.65	2.0	1.4	3.5	5.45	5.75	3.4	1.8	.55	2.3	4.9	2.1
27	1.7	1.95	1.4	3.5	5.5	5.65	3.35	1.7	.6	2.7	4.5	2.1
28	1.9	1.95	1.4	3.5	5.5	5.6	3.3	1.7	.6	2.7	4.4	2.05
29	2.0	......	1.5	3.5	5.55	5.5	3.3	1.6	.55	2.6	4.2	2.0
30	2.15	......	1.5	3.55	5.55	5.45	3.3	1.5	.5	2.6	4.0	1.95
31	2.15	......	1.5	......	5.5	......	3.3	1.45	......	2.45	......	1.9

KACHESS RIVER NEAR EASTON, WASH.

This station was established October 14, 1903. It is located 2 miles northwest of Easton, Wash., and one-half mile below the foot of Lake Kachess, at the outlet of which a dam has been constructed by the Cascade Canal Company. This dam controls the flow. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 78, where are given also references to publications that contain data for previous years.

Discharge measurements of Kachess River near Easton, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 16	J. C. Stevens	70	113	3.86	215
May 1	W. C. Muldrow	76	229	5.45	732
July 16	do	69	120	4.01	256
August 11	do	68	94	3.62	156
August 23	do	68	97	3.63	149
September 24	do	64	67	3.23	74
October 29	Muldrow and McGlashan	74	164	4.60	428
November 26	W. C. Muldrow	76	230	5.50	722

Daily gage height, in feet, of Kachess River near Easton, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	4.2	4.1	3.95	5.45	3.95	4.25	3.3	3.55	3.2	4.4	5.1
2	3.65	4.2	4.0	4.0	5.5	3.9	4.2	3.3	3.6	3.25	4.3	5.0
3	3.65	4.2	4.0	4.05	5.5	4.0	4.15	3.25	3.6	3.3	4.2	4.9
4	3.65	4.15	4.0	4.1	5.5	4.1	4.2	3.2	3.6	3.35	4.0	4.9
5	3.65	4.2	4.0	4.1	5.45	4.2	4.2	3.2	3.55	3.35	3.2	4.8
6	3.7	4.15	3.9	4.2	5.4	4.3	4.25	3.2	3.5	3.35	3.2	4.6
7	3.65	4.15	3.9	4.35	5.4	4.3	4.3	3.2	3.5	3.35	3.3	4.6
8	3.65	4.15	3.9	4.45	5.3	4.25	4.2	3.25	3.5	3.3	3.3	4.5
9	3.7	4.1	3.9	4.55	5.3	4.6	4.15	3.6	3.45	3.3	3.35	4.45
10	3.6	4.1	3.9	4.6	5.4	4.6	4.1	3.65	3.45	3.3	3.4	4.4
11	3.6	4.1	3.9	4.55	4.5	4.6	4.05	3.6	3.4	3.3	3.45	4.35
12	3.6	4.1	3.9	4.5	4.25	4.55	4.0	3.6	3.4	3.3	3.72	4.35
13	3.6	4.05	3.9	4.5	4.2	4.55	4.0	3.6	3.35	3.3	4.68	4.3
14	3.6	4.0	3.9	4.5	3.7	4.5	4.1	3.6	3.35	3.35	6.64	4.2
15	3.6	3.95	3.9	4.5	3.7	4.5	4.05	3.6	3.35	3.4	7.85	4.15
16	3.6	3.9	3.9	4.55	3.8	4.45	4.0	3.65	3.3	3.45	8.0	4.1
17	3.6	3.9	3.9	4.6	3.7	4.45	4.0	3.65	3.3	3.55	7.82	4.1
18	3.6	3.95	3.85	4.6	3.65	4.4	3.95	3.75	3.3	3.65	7.5	4.05
19	3.6	4.0	3.85	4.65	3.6	4.1	3.85	3.75	3.3	3.7	7.2	4.05
20	3.6	4.05	3.8	4.65	3.6	4.1	3.8	3.7	3.25	3.7	6.8	4.1
21	3.65	4.05	3.8	4.8	3.65	4.0	3.85	3.7	3.25	3.7	6.6	4.15
22	3.65	4.15	3.8	5.0	3.65	3.95	3.8	3.65	3.25	3.7	6.4	4.25
23	3.7	4.1	3.75	5.05	3.6	3.9	3.7	3.7	3.2	3.65	6.1	4.2
24	3.8	4.1	3.75	5.15	3.6	3.9	3.4	3.6	3.2	3.65	5.85	4.2
25	3.85	4.1	3.8	5.2	4.2	4.5	3.3	3.7	3.3	3.7	5.7	4.15
26	4.0	4.15	3.75	5.2	4.55	4.55	3.35	3.7	3.25	4.45	5.5	4.15
27	4.0	4.1	3.75	5.2	4.55	4.55	3.45	3.65	3.25	4.8	5.3	4.15
28	4.1	4.1	3.75	5.2	4.6	4.5	3.35	3.6	3.25	4.7	5.3	4.1
29	4.1	....	3.8	5.3	4.6	4.5	3.3	3.7	3.2	4.6	5.2	4.1
30	4.1	....	3.8	5.4	4.6	4.35	3.25	3.65	3.2	4.6	5.15	4.05
31	4.15	....	3.81	....	4.55	....	3.3	3.6	....	4.4	....	4.0

NOTE.—Gage heights for November 12 to 17 were found by plotting several readings a day and taking the mean from the curve.

Rating table for Kachess River near Easton, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	62	4.00	240	4.80	475	5.60	780	6.80	1,440
3.30	80	4.10	266	4.90	510	5.70	830	7.00	1,560
3.40	98	4.20	294	5.00	545	5.80	880	7.20	1,690
3.50	118	4.30	322	5.10	580	5.90	930	7.40	1,830
3.60	140	4.40	350	5.20	615	6.00	980	7.60	1,980
3.70	164	4.50	380	5.30	655	6.20	1,090	7.80	2,140
3.80	188	4.60	410	5.40	695	6.40	1,200	8.00	2,300
3.90	214	4.70	442	5.50	735	6.60	1,320		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1906 and is well defined below gage height 5.5 feet.

Monthly discharge of Kachess River near Easton, Wash., for 1906.

[Drainage area, 63 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	280	140	173	10,600	2.75	3.17
February	294	214	263	14,600	4.17	4.34
March	266	176	206	12,700	3.27	3.77
April	695	227	434	25,800	6.89	7.69
May	735	140	401	24,700	6.37	7.34
June	410	214	325	19,300	5.16	5.76
July	322	71	211	13,000	3.35	3.86
August	176	62	131	8,060	2.08	2.40
September	140	62	92.8	5,520	1.47	1.64
October	475	62	168	10,300	2.67	3.08
November	2,300	62	798	47,500	12.67	14.14
December	580	240	337	20,700	5.35	6.17
The year	2,300	62	295	213,000	4.68	63.35

NOTE.—Values are rated as follows: January to March and July to October, good; remainder of year, excellent.

CLEALUM RIVER NEAR ROSLYN, WASH.

This station was established October 10, 1903. It is located 1,000 feet below the outlet of Lake Clealum. It is 2½ miles northwest of Roslyn and 6½ miles northwest of Clealum, Wash. On March 17, 1906, the gage was lowered to the same datum as was used prior to August 28, 1905. All gage heights of 1906 refer to this datum, 17.40 feet below the bench mark, which is a large spike driven into a root on the downstream side of the blazed tree on the left bank to which the cable is fastened. The gage was read during 1906 by Mark Barkwell, Mrs. Samuel Davis, and employees of the United States Reclamation Service . The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 80, where are given also references to publications that contain data for previous years.

Discharge measurements of Clealum River near Roslyn, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 17[a]	J. C. Stevens	124	720	2.35	526
May 3	W. C. Muldrow	148	1,220	5.98	3,370
July 18[a]	do	125	753	2.90	774
August 13[b]	do	80	139	1.96	443
August 24[b]	Stevens and Muldrow	82	114	1.58	264
October 31	Muldrow and McGlashan	128	883	3.50	1,150
November 27	W. C. Muldrow	125	786	3.01	780

[a] Large amount of dead water.

[b] Measured by wading.

Daily gage height, in feet, of Clealum River near Roslyn, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.8	3.1	2.45	4.0	6.0	4.1	......	......	1.6	1.7	3.2	2.7
2	1.75	3.2	2.4	4.0	6.1	4.0	......	......	1.6	1.7	3.1	2.6
3	1.72	3.15	2.35	3.9	6.0	4.1	......	......	1.6	1.8	2.9	2.5
4	1.72	3.1	2.3	3.8	6.0	4.7	......	......	1.6	1.8	2.8	2.4
5	1.7	3.0	2.25	3.9	5.8	4.8	......	2.0	1.6	1.9	2.7	2.4
6	1.7	2.9	2.2	4.4	5.3	4.5	......	2.0	1.6	1.9	2.7	2.4
7	1.75	2.8	2.2	4.7	5.0	4.1	......	2.0	1.6	1.9	2.8	2.4
8	1.72	2.7	2.2	4.9	4.9	3.9	......	2.0	1.6	1.9	2.9	2.3
9	1.75	2.6	2.3	4.8	5.0	3.8	......	2.0	1.6	1.8	2.9	2.3
10	1.75	2.55	2.4	4.5	5.5	......	......	2.0	1.7	1.8	3.2	2.3
11	1.75	2.5	2.5	4.3	5.7	......	......	2.0	1.7	1.8	4.0	2.3
12	1.72	2.4	2.5	4.0	5.6	......	......	2.0	1.7	1.9	4.2	2.3
13	1.72	2.4	2.58	3.8	5.1	......	......	2.0	1.7	1.9	6.3	2.2
14	1.7	2.32	2.5	3.7	4.8	......	......	2.0	1.7	1.9	11.1	2.2
15	1.7	2.3	2.5	3.7	4.7	......	......	2.0	1.7	2.0	14.0	2.2
16	1.7	2.25	2.45	3.9	4.6	......	......	2.0	1.7	2.2	11.6	2.2
17	1.7	2.2	2.4	4.2	4.2	......	......	2.0	1.7	2.5	8.6	2.2
18	1.7	2.4	2.3	4.3	4.0	......	......	2.0	1.7	2.7	6.6	2.2
19	1.7	2.5	2.28	4.3	3.9	......	2.9	1.9	1.7	2.8	5.4	2.3
20	1.7	2.7	2.1	4.4	3.8	......	......	1.9	1.6	2.8	4.8	2.3
21	1.7	2.8	2.0	4.9	3.7	......	......	1.1	1.6	2.7	4.2	2.3
22	1.8	2.8	2.0	5.9	3.7	......	2.1	1.1	1.6	2.6	3.9	2.4
23	1.8	2.8	2.0	6.1	3.7	......	......	1.1	1.6	2.5	3.6	2.5
24	2.0	2.7	1.8	5.7	3.8	......	......	1.1	1.6	2.5	3.4	2.5
25	2.3	2.7	1.8	5.2	3.9	......	......	1.1	1.7	2.5	3.3	2.5
26	2.7	2.7	1.9	4.9	4.5	......	......	1.4	1.8	6.7	3.0	2.5
27	2.9	2.6	2.0	4.7	4.9	......	......	1.5	1.8	6.6	3.0	2.5
28	3.0	2.52	2.05	4.7	4.8	......	......	1.5	1.8	5.4	2.9	2.4
29	3.0	......	2.1	5.0	4.4	......	2.0	1.5	1.9	4.5	2.8	2.4
30	3.0	......	2.5	5.4	4.2	......	......	1.6	1.9	3.9	2.7	2.4
31	3.0	......	3.4	......	4.2	......	......	1.6	......	3.5	......	2.4

Rating table for Clealum River near Roslyn, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	140	2.20	460	3.30	940	4.80	1,970	6.80	4,160
1.20	165	2.30	495	3.40	995	5.00	2,150	7.00	4.400
1.30	190	2.40	530	3.50	1,050	5.20	2,350	8.00	5,800
1.40	215	2.50	570	3.60	1,110	5.40	2,550	9.00	7,340
1.50	240	2.60	610	3.70	1,170	5.60	2,760	10.00	9,040
1.60	270	2.70	650	3.80	1,230	5.80	2,980	11.00	10,900
1.70	300	2.80	695	3.90	1,295	6.00	3,200	12.00	12,940
1.80	330	2.90	740	4.00	1,360	6.20	3,440	13.00	15,200
1.90	360	3.00	785	4.20	1,500	6.40	3,680	14.00	17,700
2.00	390	3.10	835	4.40	1,640	6.60	3,920		
2.10	425	3.20	885	4.60	1,800				

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1906 and is well defined between gage heights 1.4 feet and 6.0 feet.

Monthly discharge of Clealum River near Roslyn, Wash., for 1906.

[Drainage area, 205 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	785	300	404	24,800	1.97	2.27
February	885	400	644	35,800	3.14	3.27
March	995	330	494	30,400	2.41	2.78
April	3,320	1,170	1,800	107,000	8.78	9.80
May	3,320	1,170	2,020	124,000	9.85	11.36
June 1-9	1,970	1,230	1,530	27,300	7.46	2.50
August 5-31	390	140	309	16,500	1.51	1.52
September	360	270	293	17,400	1.43	1.60
October	4,040	300	831	51,100	4.06	4.68
November	17,700	650	2,650	158,000	12.92	14.40
December	650	400	522	32,100	2.54	2.93
The period				622,000		

NOTE.—Values are rated as follows: April to June, excellent; remainder of period, good.

NACHES RIVER NEAR NILE, WASH.

This station was established June 23, 1904. It is located 1¾ miles above the highway bridge, 23 miles northwest of North Yakima, and 8 miles southeast of Nile, Wash. The station is 1¾ miles above the junction of Naches and Tieton rivers.

On November 15, 1906, the gage was destroyed by a flood. Gage heights after that date were taken from a temporary slanting gage, and have been reduced to the same datum as the old gage. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 82, where are given also references to publications that contain data for previous years.

Discharge measurements of Naches River near Nile, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 27	J. C. Stevens	189	360	4.43	1,110
May 23	W. C. Muldrow	190	409	4.80	1,530
June 23	do	192	365	4.50	1,250
July 14	do	188	268	4.00	626
August 16	do	182	174	3.46	253
November 15[a]	do	246	1,730	10.30	22,000
December 9	do	196	377	4.00	1,270

[a] Computed from slope measurement and surface floats.

Daily gage height, in feet, of Naches River near Nile, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	4.3	4.3	5.3	6.0	4.0	4.4	3.6	3.4	3.4	3.9	3.35
2	3.9	4.3	4.2	5.1	5.9	4.9	4.4	3.6	3.4	3.4	3.9	3.35
3	4.0	4.3	4.2	5.0	6.0	5.0	4.4	3.6	3.4	3.4	3.9	3.22
4	3.8	4.25	4.15	5.1	6.0	5.1	4.4	3.6	3.4	3.5	3.9	3.22
5	3.8	4.2	4.1	5.4	5.9	5.0	4.3	3.6	3.4	3.5	3.9	3.22
6	3.8	4.15	4.1	5.7	5.7	4.9	4.3	3.6	3.4	3.5	3.8	3.09
7	3.8	4.2	4.2	5.9	5.6	4.8	4.3	3.6	3.4	3.5	3.9	3.74
8	3.75	4.2	4.3	6.0	5.7	4.7	4.3	3.6	3.4	3.5	4.3	3.87
9	3.8	4.15	4.4	5.9	5.7	4.7	4.2	3.6	3.5	3.5	4.3	3.74
10	3.8	4.1	4.5	5.7	5.8	4.7	4.2	3.6	3.5	3.5	4.5	3.61
11	3.7	4.05	4.4	5.6	5.9	4.7	4.2	3.5	3.5	3.5	5.0	3.48
12	3.75	4.1	4.3	5.4	5.8	4.9	4.1	3.5	3.5	3.5	5.18	3.48
13	3.7	4.0	4.3	5.3	5.5	4.8	4.1	3.5	3.5	3.5	7.12	3.35
14	3.8	4.0	4.2	5.3	5.4	4.8	4.0	3.5	3.5	3.5	10.14	3.35
15	3.75	3.95	4.1	5.4	5.4	4.7	4.0	3.5	3.6	3.6	10.14	3.35
16	3.7	4.0	4.1	5.5	5.2	4.7	4.0	3.5	3.6	3.8	9.04	3.22
17	3.7	4.0	4.2	5.5	5.1	4.7	4.0	3.5	3.5	4.0	6.84	3.22
18	3.8	4.1	4.3	5.6	5.0	4.6	3.9	3.5	3.5	4.0	5.6	3.22
19	3.75	4.9	4.3	5.5	4.9	4.6	3.9	3.5	3.5	4.0	5.2	3.22
20	3.8	5.0	4.2	5.6	4.9	4.6	3.9	3.5	3.5	3.9	5.08	3.48
21	3.7	4.9	4.1	5.8	4.8	4.6	3.8	3.4	3.5	3.8	4.84	4.48
22	3.7	4.7	4.1	6.1	4.9	4.5	3.8	3.4	3.5	3.8	4.6	4.48
23	3.8	4.6	4.1	6.2	4.8	4.5	3.8	3.5	3.4	3.7	4.36	4.24
24	4.0	4.6	4.1	6.0	4.8	4.5	3.8	3.5	3.4	3.7	4.36	4.24
25	4.1	4.5	4.2	5.8	4.9	4.5	3.8	3.5	3.4	3.7	4.12	4.12
26	4.1	4.4	4.2	5.7	5.4	4.6	3.7	3.5	3.5	4.2	4.0	4.0
27	4.1	4.4	4.6	5.6	5.3	4.5	3.7	3.5	3.5	4.4	3.87	3.87
28	4.05	4.3	4.6	5.5	5.2	4.5	3.7	3.5	3.5	4.3	3.61	3.74
29	4.0		4.7	5.6	5.1	4.4	3.7	3.4	3.5	4.2	3.61	3.74
30	4.1		4.8	5.7	5.0	4.4	3.7	3.4	3.5	4.1	3.48	3.61
31	4.2		5.2		4.9		3.7	3.4		4.0		3.48

NOTE.—Gage lengths for November 12 to 17 were found by plotting several readings a day and taking the mean from the curve.

Rating table for Naches River near Nile, Wash., from January 1, 1905, to November 15, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.40	235	4.30	960	5.20	2,380	6.20	4,740	8.00	10,700
3.50	280	4.40	1,090	5.30	2,580	6.40	5,300	8.20	11,520
3.60	330	4.50	1,230	5.40	2,780	6.60	5,880	8.40	12,360
3.70	390	4.60	1,380	5.50	3,000	6.80	6,480	8.60	13,240
3.80	460	4.70	1,530	5.60	3,220	7.00	7,100	8.80	14,160
3.90	540	4.80	1,690	5.70	3,460	7.20	7,740	9.00	15,100
4.00	630	4.90	1,850	5.80	3,700	7.40	8,420	10.00	20,320
4.10	730	5.00	2,020	5.90	3,960	7.60	9,140		
4.20	840	5.10	2,200	6.00	4,220	7.80	9,900		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined below gage height 5 feet.

Monthly discharge of Naches River near Nile, Wash., for 1906.

[Drainage area, 636 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	840	390	513	31,500	0.807	0.93
February	2,020	585	1,010	56,100	1.59	1.66
March	2,380	730	996	61,200	1.57	1.81
April	4,740	2,020	3,250	193,000	5.11	5.70
May	4,220	1,690	2,810	173,000	4.42	5.10
June	2,200	1,090	1,530	91,000	2.41	2.69
July	1,090	390	676	41,600	1.06	1.22
August	330	235	289	17,800	.454	.52
September	330	235	267	15,900	.420	.47
October	1,090	235	458	28,200	.720	.83
November 1-15	21,100	460	4,060	121,000	6.38	3.56
The period				800,000		

NOTE.—Values are rated as follows: January to May and November, good; June to October, excellent.

NACHES RIVER NEAR NORTH YAKIMA, WASH.

The original station on Naches River was established August 14, 1893, at a point a few hundred yards above the mouth of the river, near the bridge of the Northern Pacific Railway.

On April 24, 1906, a standard chain gage was installed at the highway bridge above the cable; length of chain, 27.10 feet. After April 28, 1906, this gage was read by Mrs. A. M. Cole. The flood of November 16, 1906, swept out this gage with the bridge and changed the channel. A temporary vertical gage, installed November 22, at the same datum, was read during the remainder of the year. The bench mark is a brass plug in the top of the concrete-filled steel pier, 10 feet north of the gage; elevation, 21.74 feet above the datum of the gage and 1,093.87 feet above sea level.

The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 86, where are given also references to publications that contain data for previous years.

Discharge measurements of Naches River near North Yakima, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 26	Stevens and Muldrow	130	387	[a] 5.35	970
April 3	W. C. Muldrow	143	576	[a] 6.15	2,140
April 25	do	158	644	6.45	3,790
May 28	do	142	452	5.67	2,440
June 21	do	132	307	4.48	1,290
July 10	do	127	248	4.00	961
August 20	J. C. Stevens	57	33	2.10	40
October 26	Muldrow and McGlashan	131	322	4.40	1,230
November 14 [b]	W. C. Muldrow	270	1,820	11.50	24,300
November 22	do	240	923	8.20	3,590

[a] Gage height from inclined gage; other gage heights are from chain gage.
[b] Measured by floats.

Daily gage height, in feet, of Naches River near North Yakima, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.3	5.2	5.3	6.35	6.9	5.2	4.1	2.6	2.0	2.1	3.6	7.5
2	4.3	5.2	5.2	6.3	6.9	5.1	4.0	2.5	2.0	2.4	3.5	7.5
3	4.4	5.2	5.2	6.1	7.0	5.6	4.1	2.3	2.0	2.3	3.5	7.4
4	4.4	5.2	5.1	6.3	7.1	5.7	4.2	2.3	2.1	2.4	3.6	7.4
5	4.4	5.2	5.0	6.6	6.7	5.4	4.2	2.5	1.9	2.5	3.5	7.4
6	4.4	5.2	5.0	7.0	6.0	5.1	4.2	2.3	2.0	2.5	3.4	7.5
7	4.3	5.1	5.0	7.3	6.4	4.9	4.4	2.4	2.4	2.4	3.6	7.5
8	4.3	5.1	5.2	....	6.2	4.8	4.3	2.2	2.5	2.5	4.8	7.7
9	4.3	5.0	5.5	7.3	6.4	4.8	4.1	2.3	2.5	2.5	4.4	7.7
10	4.3	5.0	5.5	7.1	6.8	4.7	3.9	2.2	2.3	2.5	4.8	7.6
11	4.3	4.95	5.4	6.9	6.8	4.7	4.0	2.2	2.3	2.4	5.8	7.5
12	4.2	4.9	5.3	6.6	6.6	5.0	3.9	2.3	2.2	2.5	5.6	7.4
13	4.2	4.9	5.3	6.5	6.2	5.0	3.8	2.3	2.0	2.5	9.1	7.3
14	4.2	4.8	5.3	6.6	5.9	4.8	3.7	2.4	2.3	2.5	11.15	7.3
15	4.2	4.8	5.2	....	6.0	4.7	3.7	2.3	2.7	2.7	10.7	7.2
16	4.2	4.8	5.2	6.7	5.8	4.8	3.8	2.4	2.5	2.7	10.7	7.3
17	4.2	4.7	5.2	6.7	5.6	4.8	3.5	2.2	2.4	3.6	9.7	7.3
18	4.2	5.5	5.1	6.7	5.2	4.7	3.4	2.1	2.3	3.6	([a])	7.2
19	4.2	6.3	5.1	6.8	5.0	4.6	3.4	2.0	2.2	3.4	....	7.2
20	4.2	6.2	5.1	6.8	5.0	4.5	3.2	2.1	2.3	3.3	....	7.3
21	4.2	6.1	5.1	7.1	4.7	4.5	3.1	2.1	2.3	3.3	....	8.5
22	4.2	5.9	5.0	....	4.8	4.5	3.0	2.1	2.3	3.2	....	8.6
23	4.4	5.8	5.0	7.6	4.9	4.4	3.1	2.1	2.3	3.0	....	8.3
24	4.5	5.6	5.0	7.3	5.0	4.3	3.0	1.9	2.4	3.0	....	8.3
25	4.7	5.55	5.0	7.1	5.1	4.4	2.8	2.1	2.4	3.0	7.9	8.1
26	4.9	5.5	5.0	7.0	6.2	4.6	2.9	2.0	2.3	4.0	7.8	8.0
27	4.9	5.4	5.2	6.8	6.0	4.4	2.8	2.0	2.2	4.8	7.7	7.9
28	4.9	5.3	5.8	5.9	5.9	4.2	2.7	2.0	2.4	4.4	7.6	7.9
29	4.9	....	5.9	6.1	5.7	4.1	3.1	2.5	2.2	4.0	7.6	7.9
30	4.9	....	6.0	6.4	5.5	4.0	2.8	2.0	2.2	3.8	7.5	7.8
31	5.1	....	6.4	....	5.4	....	2.7	2.2	....	3.6	....	7.7

[a] Gage and bridge destroyed by flood.

Rating tables for Naches River near North Yakima, Wash.

JANUARY 1 TO APRIL 29, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.20	285	4.90	650	5.60	1,280	6.30	2,190	7.00	3,360
4.30	325	5.00	720	5.70	1,390	6.40	2,340	7.10	3,540
4.40	370	5.10	800	5.80	1,510	6.50	2,500	7.20	3,730
4.50	420	5.20	880	5.90	1,630	6.60	2,660	7.30	3,920
4.60	470	5.30	970	6.00	1,760	6.70	2,830	7.40	4,110
4.70	525	5.40	1,070	6.10	1,900	6.80	3,000	7.50	4,300
4.80	585	5.50	1,170	6.20	2,040	6.90	3,180	7.60	4,500

APRIL 28 TO NOVEMBER 14, 1906.[b]

1.10	5	2.10	45	3.10	365	4.20	1,055	6.20	3,350
1.20	7	2.20	60	3.20	415	4.40	1,210	6.40	3,670
1.30	9	2.30	75	3.30	470	4.60	1,380	6.60	4,000
1.40	11	2.40	95	3.40	525	4.80	1,570	6.80	4,340
1.50	14	2.50	120	3.50	585	5.00	1,780	7.00	4,700
1.60	17	2.60	150	3.60	645	5.20	2,000	8.00	6,880
1.70	21	2.70	185	3.70	710	5.40	2,240	9.00	10,100
1.80	25	2.80	225	3.80	775	5.60	2,500	10.00	14,800
1.90	30	2.90	270	3.90	840	5.80	2,770	11.00	20,900
2.00	35	3.00	315	4.00	910	6.00	3,050		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is fairly well defined below gage height 6.2 feet.

[b] This table is applicable only for open-channel conditions. It is based on 7 discharge measurements made during 1906 and is well defined between gage heights 2.0 feet and 6.5 feet.

Monthly discharge of Naches River near North Yakima, Wash., for 1906.

[Drainage area, 1,120 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	800	285	395	24,300	0.353	0.41
February	2,190	525	1,030	57,200	.920	.96
March	2,340	720	982	60,400	.877	1.01
April	4,500	1,900	3,120	186,000	2.79	3.11
May	4,890	1,470	3,040	187,000	2.71	3.12
June	2,630	910	1,550	92,200	1.38	1.54
July	1,210	185	646	39,700	.577	.67
August	150	30	67.6	4,160	.060	.07
September	185	30	74.8	4,450	.067	.07
October	1,570	45	386	23,700	.345	.40
November 1-14	21,900	525	3,300	91,600	2.95	1.54
The period				771,000		

NOTE.—Values are rated as follows: January to April, good; July to November, fair.

BUMPING RIVER NEAR NILE, WASH.

This station was established June 13, 1906, for the Tieton project of the United States Reclamation Service. It is located at the outlet of Bumping Lake.

Discharge measurements are made by wading.

The gage, which was read during a part of 1906 by employees of the Reclamation Service, is a vertical staff fastened to the stump of a tree, at the point where the trail crosses the river, 2,000 feet below the lake.

Discharge measurements of Bumping River near Nile, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 13	W. C. Muldrow	110	193	1.40	352
July 9	C. E. Hewitt	120	171	1.02	266
July 14	do	116	141	.76	198
July 18	do	115	126	.63	161
July 23	do	115	114	.52	136
July 28	do	115	105	.44	120
November 14[a]	W. C. Muldrow	140	900	7.00	6,000
December 7	do	110	201	1.50	407

[a] Computed from measurements of slope.

Daily gage height, in feet, of Bumping River near Nile, Wash., for 1906.

Day.	June.	July.	Day.	June.	July.	Day.	June.	July.
1		1.05	12		.85	23	1.15	0.5
2		1.05	13	1.5	.8	24	1.1	.5
3		1.05	14	1.4	.75	25	1.1	.5
4		1.2	15	1.35	.75	26	1.1	.5
5		1.15	16	1.4	.7	27	1.1	.45
6		1.2	17	1.35	.65	28	1.05	.45
7		1.1	18	1.3	.65	29	1.05	.45
8		1.05	19	1.25	.6	30	1.05	.4
9		1.0	20	1.2	.6	31		.4
10		.9	21	1.2	.6			
11		.9	22	1.15	.55			

Rating table for Bumping River near Nile, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	122	0.70	176	1.00	251	1.30	347
0.50	137	0.80	199	1.10	281	1.40	382
0.60	155	0.90	224	1.20	314	1.50	417

NOTE.—The above table is applicable only for open-channel conditions. It is based on 7 discharge measurements made during 1906 and is well defined.

Monthly discharge of Bumping River near Nile, Wash., for 1906.

[Drainage area 68 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
June 13-30	417	266	318	11,400	4.68	3.13
July	314	122	195	12,000	2.87	3.31
The period				23,400		

NOTE.—Values are rated as excellent.

TIETON RIVER AT HEADWORKS NEAR NACHES, WASH.

This station was established March 29, 1906. It is located 1 mile below the diversion point of the proposed canal of the Tieton project of the Reclamation Service, about 15 miles from the mouth of the river.

The river flows in a narrow canyon cut in basalt. The channel is straight. The right bank is low and brush-covered, and overflows at high water; the left is fairly high and clean. The bed of the stream is of bowlders and gravel, and permanent. There is one channel at all stages. The current is swift and somewhat broken.

Measurements are made from a cable and car.

A vertical 1 by 4 inch gage is drift-bolted to a bowlder at the cable station. The bench mark is a spike in the root of a large pine, 50 feet southeast of the stump to which the cable is attached; elevation, 16.11 feet above the datum of the gage.

Discharge measurements of Tieton River at headworks near Naches, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 12	W. C. Muldrow	75	158		416
March 29	J. C. Stevens	94	182	3.47	525
April 17	W. C. Muldrow	95	220	3.90	763
June 2	do	95	195	3.66	644
September 8	do	76	142	3.12	352

Daily gage height, in feet, of Tieton River at Headworks near Naches, Wash., for 1906.

Day.	Apr.	May.	June.	July.	Sept.	Day.	Apr.	May.	June.	July.	Sept.
5		4.25				21	4.4	3.6		3.25	
7		4.2				22	4.6				
12		4.3				23	4.45				
13		4.0				24	4.3			3.3	
14		4.0				25	4.15				
15		4.0				26	4.0				
16		3.9				27	4.0				
17	3.9	3.8			2.86	28	3.95		2.4		
18	3.9	3.65				29	4.2				
19	3.9	3.6				30	4.3				
20	4.1	3.7									

TIETON RIVER NEAR NACHES,[a] WASH.

This station was established April 24, 1902, at a point immediately below the mouth of Oak Creek, in sec. 3, T. 14 N., R. 16 E. of the Willamette meridian, about 3 miles above the mouth of Tieton River and about 22 miles from North Yakima by road. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 89, where are given also references to publications that contain data for previous years. The station was moved upstream March 7, 1906, above the mouth of Oak Creek.

The channel is straight. The banks are high and do not overflow. The bed of the stream is of gravel and solid basalt and changes only during extreme floods. There is one channel at all stages. The current is very swift.

Measurements are made by means of a cable, car, and tagged wire.

The gage, which was read twice a day by Oscar M. Cobb during 1906, is a vertical staff, in two sections: The lower section is bolted to the downstream side of a large bowlder; the upper section is spiked to a tree 20 feet upstream. The bench mark is the highest point of the bowlder to which the gage is attached; elevation, 1,694.65 feet above sea level and 9.25 feet above the datum of the gage.

Discharge measurements of Tieton River near Naches, Wash., in 1906–7.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1906.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 7	W. C. Muldrow	69	147	[b] 6.10	333
March 27	J. C. Stevens	73	160	6.40	474
March 30	do	74	180	6.71	645
May 22	W. C. Muldrow	73	173	6.63	603
June 22	do	72	166	6.41	532
July 14	do	74	187	6.70	657
August 15	do	71	151	6.20	414
November 16[c]	do	125	728	9.70	5,540
1907.					
February 2	do	65	212	4.80	580

[a] Station formerly referred to as near North Yakima, Wash.
[b] Old gage read 7.20 feet.
[c] Measured by floats.

Daily gage height, in feet, of Tieton River near Naches, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.50	7.30	7.18	6.95	7.65	6.75	6.60	6.16	5.98	5.68	6.80	5.15
2	6.47	7.30	7.18	6.80	7.55	6.78	6.68	6.12	5.92	5.82	5.70	5.10
3	6.60	7.22	7.20	6.78	7.65	7.00	6.85	6.08	5.98	5.90	6.72	5.05
4	6.65	7.15	7.15	6.92	7.70	7.18	6.85	6.12	5.90	5.75	6.88	5.00
5	6.65	7.12	7.10	7.20	7.52	6.90	6.95	6.12	5.90	5.65	5.90	5.00
6	6.62	7.00	7.10	7.42	7.40	6.75	6.95	6.20	6.05	6.68	5.80	5.75
7	6.60	6.98	7.20	7.70	7.35	6.65	6.90	6.18	6.18	5.70	6.00	5.52
8	6.60	7.05	7.30	7.58	7.38	6.58	6.80	6.22	6.05	6.78	6.92	5.52
9	6.60	6.98	6.25	7.45	7.50	6.55	6.70	6.30	5.88	5.70	6.70	5.40
10	6.55	6.95	0.25	7.28	7.62	6.48	0.72	6.22	5.68	5.75	7.55	5.30
11	6.55	6.88	0.05	7.12	7.62	6.62	6.7	6.25	6.58	6.75	7.25	5.28
12	6.55	6.92	6.00	6.98	7.42	6.95	6.68	6.25	5.60	5.75	8.60	5.15
13	6.58	6.90	6.00	6.92	7.30	6.75	6.62	6.25	5.55	5.65	11.80	5.02
14	6.50	6.90	6.02	6.92	7.15	6.58	6.65	6.10	6.68	5.81	13.75	4.92
15	6.50	6.88	6.00	7.02	7.25	6.58	6.58	0.22	5.68	5.78	13.70	5.00
16	6.58	6.85	6.00	7.12	7.00	6.68	6.55	6.10	5.60	0.08	10.00	4.95
17	6.52	6.88	6.00	7.12	6.82	6.65	6.48	6.00	5.72	6.15	7.75	4.95
18	6.48	7.50	5.98	7.10	6.72	6.58	6.38	6.00	5.85	5.92	7.25	4.92
19	6.55	8.60	5.95	7.12	6.68	6.52	6.35	5.92	5.90	5.78	6.90	5.00
20	6.50	8.18	5.95	7.30	6.62	6.48	6.28	5.95	6.90	5.72	6.50	6.15
21	6.50	7.90	5.92	7.62	6.62	6.52	6.30	5.92	5.90	6.68	6.25	7.25
22	6.50	7.75	5.92	7.70	6.60	6.45	6.38	5.90	5.82	5.62	6.05	6.85
23	6.60	7.65	5.95	7.65	6.65	6.40	6.30	5.75	5.85	5.62	5.82	6.55
24	6.80	7.58	6.02	7.45	6.65	6.55	6.22	5.90	5.90	5.62	5.72	6.60
25	6.82	7.45	6.08	7.30	7.18	6.58	6.25	6.05	5.78	6.00	5.62	6.25
26	6.90	7.42	6.22	7.22	7.50	6.75	6.28	6.05	6.65	7.20	5.48	6.10
27	7.05	7.38	6.40	7.20	7.16	0.55	6.20	6.05	5.62	6.72	5.40	6.95
28	6.90	7.30	6.60	7.22	7.00	6.45	6.22	6.05	5.82	0.32	5.32	6.85
29	6.92	......	6.60	7.30	6.88	6.32	6.25	6.08	5.72	6.10	5.30	5.78
30	7.05	......	6.75	7.35	6.82	6.40	6.25	6.12	5.68	5.98	5.20	5.70
31	7.22	......	7.15	......	6.72	......	0.22	6.05	......	5.88	......	6.55

NOTE.—Gage heights prior to March 9 are for a different gage and datum from those after that date. Gage heights from November 12 to 17 were found by plotting several readings a day and taking the mean from the curve.

Rating tables for Tieton River near Naches, Wash.

JANUARY 1, 1905, TO MARCH 8, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
6.30	195	6.80	249	7.30	365	7.80	575	8.30	920
6.40	202	6.90	267	7.40	400	7.90	630	8.40	1,020
6.50	210	7.00	287	7.50	440	8.00	690	8.50	1,130
6.00	220	7.10	310	7.60	480	8.10	755	8.60	1,250
6.70	233	7.20	335	7.70	525	8.20	830		

MARCH 9 TO NOVEMBER 14, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
5.50	155	6.60	593	7.70	1,370	8.80	2,530	10.80	5,720
6.60	182	6.70	649	7.80	1,460	8.90	2,650	11.00	6,120
6.70	212	6.80	708	7.90	1,555	9.00	2,780	11.20	6,560
5.80	244	6.90	770	8.00	1,650	9.20	3,040	11.40	7,000
5.90	278	7.00	835	8.10	1,750	9.40	3,320	11.60	7,440
6.00	315	7.10	905	8.20	1,850	9.60	3,610	11.80	7,920
6.10	355	7.20	975	8.30	1,960	9.80	3,920	12.00	8,400
6.20	398	7.30	1,050	8.40	2,070	10.00	4,240	13.00	11,000
6.30	443	7.40	1,125	8.50	2,180	10.20	4,580	14.00	14,000
6.40	490	7.50	1,205	8.60	2,290	10.40	4,940	15.00	17,700
6.50	540	7.60	1,285	8.70	2,410	10.60	5,320		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-6, and is well defined between gage heights 6.7 feet and 7.3 feet.

[b] This table is applicable only for open-channel conditions. It is based on 7 discharge measurements made during 1906, and is well defined between gage heights 6 feet and 7 feet. The table has been extended beyond these limits by means of curves of area and mean velocity.

Rating tables for Tieton River near Naches, Wash.—Continued.

NOVEMBER 15 TO DECEMBER 31, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.90	530	5.80	1,030	6.70	1,740	7.60	2,665	9.00	4,480
5.00	560	5.90	1,100	6.80	1,830	7.70	2,780	10.00	6,000
5.10	600	6.00	1,170	6.90	1,925	7.80	2,900	11.00	7,750
5.20	645	6.10	1,245	7.00	2,020	7.90	3,020	12.00	9,800
5.30	700	6.20	1,320	7.10	2,120	8.00	3,140	13.00	12,200
5.40	760	6.30	1,400	7.20	2,225	8.20	3,390	14.00	14,950
5.50	825	6.40	1,480	7.30	2,330	8.40	3,650		
5.60	890	6.50	1,565	7.40	2,440	8.60	3,920		
5.70	960	6.60	1,650	7.50	2,550	8.80	4,195		

[a] This table is applicable only for open-channel conditions. It is based on 2 discharge measurements made during 1906-7 and the form of previous curves, and is not well defined.

Monthly discharge of Tieton River near Naches, Wash., for 1906.

[Drainage area, 289 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	341	208	232	14,300	0.803	0.93
February	1,250	258	401	22,300	1.39	1.45
March	940	285	382	23,500	1.32	1.52
April	1,370	696	1,000	59,500	3.46	3.86
May	1,370	593	956	58,800	3.31	3.82
June	961	452	616	36,700	2.13	2.38
July	802	398	560	34,400	1.94	2.24
August	420	228	350	21,500	1.21	1.40
September	389	168	250	14,900	.865	.97
October	975	188	289	17,800	1.00	1.15
November	14,100	212	2,220	132,000	7.68	8.57
December	2,280	536	921	56,600	3.19	3.68
The year	14,100	168	681	492,000	2.36	31.97

NOTE.—Values are rated as follows: January to May, good; June to October, excellent; November and December, fair.

LOW-WATER MEASUREMENTS OF TRIBUTARIES OF LAKE KACHESS.

Small streams discharging into Lake Kachess were measured during the low-water season of 1906 with the following results:

Discharge measurements at low water of tributaries of Kachess Lake, Washington, in 1906.

Date.	Stream.	Discharge.
	East shore:	*Sec.-ft.*
August 22	First creek from outlet	1.0
August 22	Second creek from outlet	2.2
August 22	Third creek from outlet	1.6
August 22	Fourth creek from outlet	2.1
August 22	Fifth creek from outlet	1.0
August 22	Sixth creek from outlet	0.3
August 22	Honolulu Creek	0.5
	West shore:	
August 22	Main Creek	5.8
August 22	Tributary to Main Creek	0.1
August 23	Ninth creek from outlet	0.4
August 23	Eighth creek from outlet	0.1
August 23	Seventh creek from outlet	0.2
August 23	Box Canyon	14
August 23	Gale Creek	0.8
August 23	Fourth creek from outlet	0.5
August 23	Third creek from outlet	0.2
August 23	Second creek from outlet	0.7
August 23	First creek from outlet	1.5

LOW-WATER MEASUREMENTS OF TRIBUTARIES OF LAKE KEECHELUS.

A number of tributaries of Lake Keechelus were measured during the low-water season of 1906, and the results are shown in the following table:

Discharge measurements at low water of tributaries of Keechelus Lake in 1906.

Date.	Stream.	Width.	Area of section.	Discharge.
	East shore:	*Feet.*	*Sq. ft.*	*Sec.-ft.*
August 21[a]	First creek from outlet	3.5	0.8	0.8
August 21[b]	Second creek from outlet			.2
August 21	Trout Creek			1.8
August 21	Fourth creek from outlet	5	1.25	1.8
August 21	Fifth creek from outlet			0.5
August 21	Sixth creek from outlet			6
August 21[b]	Boulder Creek			2.5
August 21[a]	Gold Creek	15	7.5	25
	West shore:			
August 21	Coal Creek	5	2.8	2.5
August 21	Roaring Creek	15	12	36
August 21[c]	Meadow Creek	10	4	3.6

[a] Measured by floats one-half mile above mouth.

[b] Estimated.

[c] Measured by floats 1 mile above mouth.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous discharge measurements were made in Yakima River drainage basin during 1906:

Atanum Creek.—Measurements were made 2½ miles below Tampico:

April 20 (high water), width, 29 feet; area, 69 square feet; discharge, 207 second-feet.

August 28 (low water), width, 20 feet; area, 11 square feet; discharge, 7.6 second-feet.

A measurement was made at low water August 29 at The Narrows. The water surface was 3.82 feet below a spike in a tree on the right bank near the foot log:

Width, 20 feet; area, 20 square feet; discharge, 20 second-feet.

North Fork of Atanum Creek.—Measurements made at Tampico. The reference point is a nail in a stump on the right bank 2 feet above the second bridge; gage heights are below the reference point:

April 19, width, 30 feet; area, 52 square feet; gage height, −2.00 feet; discharge, 190 second-feet.

August 28, width, 16 feet; area, 11 square feet; gage height, −3.62 feet; discharge, 20 second-feet.

August 29, discharge, 17 second-feet; creek in four channels.

South Fork of Atanum Creek.—Measurements were made 1 mile above Tampico:

April 20 (high water); width, 16 feet; area, 18 square feet; discharge, 54 second-feet.

August 29 (low water); width, 11 feet; area, 10 square feet; discharge, 8.6 second-feet.

Cabin Creek near Easton, Wash.—The discharge of this stream at the wagon bridge on Snoqualmie Road was estimated August 21, at low water, as 7 second-feet.

Clealum River above Lake Clealum.—A measurement was made August 24, 1906, at low water, 2 miles above the head of the lake:

Width, 53 feet; area, 75 square feet; discharge, 189 second-feet.

Cowiche Creek near Cowiche, Wash.—A measurement was made June 3, 1906, just below the head of Cowiche canal:

Width, 18 feet; area, 31 square feet; discharge, 37 second-feet.

South Fork of Cowiche Creek near Cowiche, Wash.—Measurements were made just above the head of the canal:

April 18; width, 19 feet; area, 33 square feet; discharge, 64 second-feet.
September 1; width, 2 feet; area, 0.75 square foot; discharge, 0.71 second-foot.

North Fork of Cowiche Creek.—A measurement was made by floats April 18, 1906, at the corner of sections 20, 21, 28, and 29, T. 14 N., R. 17 E.:

Width, 6 feet; area, 1.8 square feet; discharge, 2.7 second-feet.

Desolation Creek near Roslyn, Wash.—A measurement was made at low water August 24, 1906, one-half mile above mouth:

Width, 4 feet; area, 2 square feet; discharge, 3.4 second-feet.

Oak Creek near Naches, Wash.—This stream is tributary to Tieton River. A measurement was made March 8, 1906, at medium stage:

Width, 7 feet; area, 8.2 square feet; discharge, 13 second-feet.

Silver Creek near Easton, Wash.—A measurement was made by floats at low water, April 23, 1906, at the mouth of canyon:

Width, 7 feet; area, 2.4 square feet; discharge, 3.4 second-feet.

Taneum Creek near Thorp, Wash.—A measurement was made at the highway bridge, 3 miles west of Thorp, March 19, 1906. The water surface was 4.17 feet below a spike in the downstream end of a 12-by-12 inch cap of bent at the left end of the bridge. The stream was at medium stage:

Width, 20 feet; area, 19 square feet; discharge, 22 second-feet.

Yakima River at Easton, Wash.—This station, which was discontinued November 28, 1904, is described in Water-Supply Paper No. 135, page 78. The following measurement was made March 16, 1906:

Width, 146 feet; area, 255 square feet; gage height, 5.30 feet; discharge, 585 second-feet.

Yakima River near Sunnyside, Wash.—A measurement was made at low water August 3, 1906, below Sunnyside dam:

Width, 70 feet; area, 65 square feet; discharge, 45 second-feet.

Yakima River near Richland.—A measurement was made at extreme low water August 17, 1906, 500 feet below the highway bridge.

Water surface 16.15 feet below spike marked "R. P." in downstream end of cap of first pile-pin at right abutment of bridge:

Width, 54 feet; area, 23 square feet; discharge, 29 second-feet.

CANALS IN YAKIMA VALLEY, WASHINGTON.

Descriptions and discharge data of the canals in Yakima Valley are given in Water-Supply Paper No. 178, pages 52-78. Systematic observations of gage heights and discharge were discontinued on most of the canals during 1906.

SUNNYSIDE CANAL NEAR YAKIMA, WASH.

This canal heads on the left bank of Yakima River 5 miles below the town of Yakima. It is owned and operated by the United States Reclamation Service. Measurements are made from a footbridge 200 feet below the head gate. The gage is a vertical staff on the right bank.

Discharge measurements of Sunnyside Canal near Yakima, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 22	W. C. Muldrow	30	17	0.70	14
April 30	do	46	189	4.63	610
June 25	do	45	193	4.80	606
August 3	do	45	166	4.15	484
September 19	do	45	150	3.80	416
September 29	Stevens and Grover	45	153	3.85	410

Daily gage height, in feet, of Sunnyside Canal near Yakima, Wash., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	0.6	4.6	4.45	4.9	4.6	3.8	17	3.6	4.7	4.0	5.2	4.55	4.0
2	.6	4.6	4.35	4.9	4.5	3.75	18	3.9	4.7	4.0	5.2	3.8	4.0
3	.6	4.6	4.35	4.9	4.15	3.6	19	3.9	4.7	4.0	5.2	4.2	3.9
4	.6	4.6	4.35	4.9	4.1	3.6	20	4.0	4.7	4.25	5.2	4.2	3.8
5	1.4	4.6	4.35	4.9	4.0	3.6	21	4.2	4.7	4.25	5.2	4.1	3.4
6	1.6	4.6	1.0	4.9	3.85	3.6	22	4.2	4.7	4.55	5.2	3.9	3.8
7	1.9	4.6	3.8	5.0	3.75	3.7	23	4.2	4.7	4.7	5.2	3.9	3.8
8	2.1	4.6	4.05	5.1	4.15	4.0	24	4.35	4.7	4.7	5.2	4.1	3.8
9	2.5	4.7	4.0	5.1	4.1	3.85	25	4.35	4.7	4.8	5.2	3.9	3.8
10	2.8	4.7	4.0	5.1	4.15	4.0	26	4.5	4.6	4.9	5.2	3.9	3.8
11	2.8	4.7	4.0	5.1	4.15	3.85	27	4.5	4.6	4.9	5.2	3.9	3.8
12	2.8	4.7	4.0	5.2	4.5	4.0	28	4.5	4.6	4.9	5.2	3.8	3.8
13	3.0	4.7	4.0	5.2	4.6	4.1	29	4.5	4.6	4.9	5.2	4.0	3.8
14	3.0	4.7	4.0	5.2	4.6	4.1	30	4.63	4.6	4.9	5.2	4.0	3.8
15	3.3	4.7	4.0	5.2	4.5	4.0	31	......	4.45	......	4.85	3.8	......
16	3.6	4.7	4.0	5.2	4.6	4.0							

Rating table for Sunnyside Canal near Yakima, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	12	1.50	75	2.40	180	3.30	317	4.40	529
0.70	16	1.60	85	2.50	194	3.40	334	4.60	572
0.80	20	1.70	95	2.60	208	3.50	352	4.80	616
0.90	26	1.80	106	2.70	222	3.60	370	5.00	660
1.00	33	1.90	117	2.80	237	3.70	389	5.20	704
1.10	41	2.00	129	2.90	252	3.80	408		
1.20	49	2.10	141	3.00	268	3.90	427		
1.30	57	2.20	154	3.10	284	4.00	447		
1.40	66	2.30	167	3.20	300	4.20	487		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is fairly well defined.

Monthly discharge of Sunnyside Canal near Yakima, Wash., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April	579	12	318	18,900
May	594	540	583	35,800
June	638	33	499	29,700
July	704	627	684	42,100
August	572	398	476	29,300
September	467	334	414	24,600
The period				180,000

NOTE.—Values are rated as good.

NEW RESERVATION CANAL NEAR YAKIMA, WASH.

This canal heads on the right bank of Yakima River a short distance below Union Gap gaging station on Yakima River. It is owned and operated by the Indian Department for the irrigation of lands in the Yakima Indian Reservation. Measurements are made at the highway bridge 2,000 feet below head-gate. The gage is a vertical staff attached to the bridge.

Discharge measurements of New Reservation Canal near Yakima, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 22	J. C. Stevens	38	21	[a]0.60	23
June 29	W. C. Muldrow	40	149	3.55	255
August 3	do	40	149	3.60	145
August 7	do	40	121	3.00	86
September 19	do	40	111	2.60	95
November 5	Muldrow and McGlashan	40	53	1.29	53

[a] Gage height uncertain.

Daily gage height, in feet, New Reservation Canal near Yakima, Wash., for 1906.

Day.	Apr.	May.	June.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	Aug.	Sept.	Oct.
1		1.9	2.3		2.6	2.6	17		2.3	2.3	2.8	2.6	2.6
2		2.1	2.3	3.7	2.6	2.6	18		2.3	2.3	3.45	2.6	2.6
3		2.2	2.4	3.6	2.6	2.6	19		2.2	2.3	2.6	2.6	1.3
4		2.2	2.4	3.6	2.6	2.6	20		2.2	.0	2.6	2.6	1.3
5		2.2	2.5	3.6	2.6	2.6	21		2.3	.0	2.6	2.6	1.3
6		2.3	.0	3.6	2.6	2.6	22	1.5	2.3	2.4	2.6	2.6	1.3
7		.0	2.3	2.9	2.6	2.6	23	1.7	2.4	2.7	2.6	2.6	1.3
8		2.4	.0	2.9	2.6	2.6	24	1.6	2.5	2.7	2.6	2.6	1.3
9		2.4	2.2	2.0	2.6	2.6	25	1.6	2.5	2.9	2.6	2.6	1.3
10		2.4	2.2	1.9	2.6	2.6	26	1.8	2.6	3.1	2.6	2.6	1.3
11		2.5	.0	1.9	2.6	2.6	27	1.6	2.5	3.4	2.6	2.6	1.3
12		2.5	2.2	1.9	2.6	2.6	28	1.8	2.3	3.5	2.6	2.6	1.3
13		2.4	2.1	1.9	2.6	2.6	29	1.8	2.3	3.6	2.6	2.6	1.3
14		2.4	2.1	2.8	2.6	2.6	30	1.9	2.3	3.6	2.6	2.6	1.3
15		2.5	2.3	2.8	2.6	2.6	31		2.3		2.6		1.3
16		2.5	2.3	2.8	2.6	2.6							

NOTE.—The growth of certain water plants reduces the velocity of the canal as the season progresses, therefore there is not a constant relation between gage height and discharge.

OLD RESERVATION CANAL NEAR WAPATO, WASH.

This canal takes water from the right bank of Yakima River, 4 miles below Wapato. It is owned and operated by the Indian Department for irrigation of lands in the Yakima Indian Reservation. Measurements are made from railroad bridge one-half mile below head-gate. The gage is a vertical staff at the railroad bridge.

Discharge measurements of Old Reservation Canal near Wapato, Wash., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 22	W. C. Muldrow	11.5	5.6	0.45	4.6
June 29	do	14.0	38	3.10	152
August 3	do	11.8	22	1.75	65
August 7	do	11.3	18	1.40	40
September 19	do	11.3	22	1.85	65
November 5	H. D. McGlashan	12.0	15	1.39	36

Daily gage height, in feet, of Old Reservation Canal near Wapato, Wash., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	......	3.2	3.1	3.0	......	1.4	1.3
2	......	......	2.0	3.0	......	1.4	1.3
3	......	......	2.0	3.0	1.75	1.4	1.3
4	......	3.3	2.0	3.0	1.75	1.4	1.3
5	......	......	2.0	3.1	1.75	1.4	1.3
6	......	......	2.0	3.2	1.5	1.8	1.3
7	......	3.1	2.0	3.1	1.4	1.8	1.3
8	......	......	2.0	3.2	1.45	1.8	1.3
9	......	......	2.0	3.1	.8	1.8	1.3
10	......	......	2.0	3.0	.8	1.8	1.3
11	......	3.1	2.0	3.0	.8	1.8	1.3
12	......	......	2.0	3.0	.8	1.8	1.3
13	......	......	2.0	3.0	.8	1.8	1.3
14	......	3.2	2.0	3.0	1.7	1.8	1.3
15	......	3.2	2.0	3.0	1.7	1.8	1.3
16	......	3.2	2.0	3.0	1.7	1.8	1.3
17	......	3.15	2.0	3.0	1.7	1.8	1.3
18	......	......	2.55	2.9	1.7	1.8	1.3
19	......	3.2	3.3	2.9	1.7	1.8	1.3
20	......	3.2	3.3	2.8	1.6	1.8	1.3
21	......	3.2	3.3	2.8	1.6	1.8	1.3
22	......	3.2	3.2	2.7	1.55	1.8	1.3
23	......	3.2	3.2	2.6	1.55	1.8	1.3
24	3.1	3.2	3.1	2.6	1.4	1.8	1.3
25	......	3.2	3.1	2.55	1.4	1.8	1.3
26	3.22	3.4	3.1	2.5	1.4	1.8	1.3
27	......	3.4	3.1	2.5	1.4	1.8	1.3
28	3.2	3.5	3.0	2.4	1.4	1.8	1.3
29	......	3.3	3.0	2.3	1.4	1.3	1.3
30	......	3.3	3.0	2.2	1.4	1.3	1.3
31	......	3.1	......	2.1	1.4	......	1.3

Rating table for Old Reservation Canal near Wapato, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	6	1.20	31	1.90	70	2.60	117	3.30	163
0.60	9	1.30	36	2.00	77	2.70	124	3.40	170
0.70	12	1.40	41	2.10	83	2.80	131	3.50	177
0.80	15	1.50	46	2.20	89	2.90	138		
0.90	18	1.60	52	2.30	96	3.00	145		
1.00	22	1.70	58	2.40	103	3.10	152		
1.10	26	1.80	64	2.50	110	3.20	159		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1906 and is well defined.

Monthly discharge of Old Reservation Canal near Wapato, Wash., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May	177	152	159	9,780
June	163	77	112	6,660
July	159	83	133	8,180
August	75	15	45.5	2,800
September	64	36	58.3	3,470
October	36	36	36.0	2,210
The period				33,100

NOTE.—Values are rated as good.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made on canals in Yakima Valley, Washington, in 1906.

Miscellaneous measurements of canals in Yakima River drainage basin, Washington, in 1906.

Date.	Canal.	Locality.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 6	Bull	Head-gate, Ellensburg	6	8.8	1.78	20
March 19	Cascade	Upper flume, Thorp	8	6.4	0.80	22
April 18	Cowiche	2 miles above Cowiche	7	6.3		11
June 3	do	Head-gate, Cowiche	5	5.5		12
September 1	do	do	2	0.48		0.26
April 20	Farmers ditch	Highway crossing, Tampico	3.5	2.4		4.1
April 15	Fortune	Foster's ranch	5.7	2.3	0.45	1.4
April 7	Fowler	North Yakima	9.7	5.3		6.5
April 22	do	do	9.7	9.7	0.70	27
April 22	Granger	do	3.5	0.52		0.46
August 4[a]	Hatch	Toppenish	6	4.2		4
April 7	Hubbard	North Yakima	13.1	17	1.30	12
April 22	do	do	15	25	1.75	31
April 22	Moxee	do	10	12	2.03	14
August 16	Old Union	North Yakima:				
		2,000 feet below head-gate	14	36	2.82	42
		At head-gate	12.2	20	1.44	29
		do	12.2	18	1.40	27
		do	11.5	16	1.21	17
		do	12.7	23	1.75	40
		2,000 feet below head-gate			2.65	29
August 6	Olsen	Ellensburg	11	25	2.50	40
May 17	Prosser	Prosser	6.5	12	2.12	18
May 23	Selah Valley	Natchez:				
		Wastegate No. 12	6.8	14		56
		Above control gates	8.5	26		78
		Below control gates	8.8	26	2.75	75
		At flume No. 8	8.0	20		67
		At flume No. 23	6.8	17		62
		At head-gate	18.5	42	3.58	93
April 20	Shaw ditch	1½ miles above Atanum	14	10		6.0
April 20	Stair ditch	2 miles above Atanum	4.5	2.5		4.7
March 19[b]	Taneum	Thorp	10.5	5.9	0.57	11
May 5	Town	Ellensburg	14	38	2.68	115
August 6	do	do	14	40	2.85	125
April 3	do	North Yakima	5.7	6	1.00	7.5
April 3	do	do	5.7	6.2	1.08	8.3
April 3	do	do	5.7	9.5	1.71	20
April 15	do	do	5.7	7.5	1.26	11
March 1	Union	do	11.5	11	0.98	9
August 16	do	Naches avenue, North Yakima	6	13	2.52	33
April 26	Union Gap	North Yakima	3.8	1.7	0.45	1.5
August 9[c]	Wapaton	do	2.0	54		117
April 5	Yakima Valley (Congdon).	Head	8.5	8.6	0.48	12

[a] Measured by floats.
[b] Water probably raised by ice gorge below.
[c] Three-fourths mile below head-gate.

SNAKE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Snake River, the largest tributary of the Columbia, rises among the high peaks of the Rocky Mountains in Yellowstone National Park, western Montana and eastern Wyoming, heading in the divide from which streams flow northward and eastward into the Missouri and southward and westward to the Colorado and the lakes of the Great Basin. From Shoshone, Lewis, and Hart lakes, in Yellowstone National Park, the south fork of the river flows southward, broadening into Jackson Lake (4 miles wide and 18 miles long) and passing through Jackson Valley (8 miles wide and 40 miles long), beyond which, near the Idaho-Wyoming line, it enters a long canyon. In the southern part of Fremont County, Idaho, it unites with North Fork. Below the junction of the forks it flows westward across Idaho to a point near Homedale, where it turns abruptly northward, forming for about 170 miles the boundary between Idaho and Oregon and for 30 miles more that between Idaho and Washington. At Lewiston it crosses into Washington, flows northwest, west, and southwest, and joins the Columbia at Pasco Junction.

Its upper drainage basin comprises the timbered mountainous country west and southwest of Yellowstone Lake. The east side of its valley is bounded by the Wind River Range, from the slopes of which it receives a number of tributaries, and the west side by the high Teton Mountains, from which most of the drainage flows westward through Teton River into North Fork.

Below the junction of North and South forks the Snake receives many important tributaries, among which may be mentioned Boise, Salmon, Clearwater, and Palouse rivers from the north and east and Owyhee, Malheur, Powder, and Grande Ronde rivers from the south and west.

The Owyhee, which joins the Snake at Owyhee, Oreg., drains a high, broken, timberless area, in portions of which the rainfall amounts to but 8 or 10 inches per annum. In many respects the drainage area of the Malheur is similar to that of the Owyhee, but parts of the headwater region are mountainous and rather heavily timbered. The drainage basin of the Grande Ronde, comprising the eastern slope of the Blue Mountains and the western slope of the Cornucopia Range in northeastern Oregon, is throughout mountainous and heavily timbered, and for much of its course the river occupies a deep canyon. Wallowa River, its principal tributary, closely resembles it. Grande Ronde Valley, a broadening of the Grande Ronde basin at the town of La Grande, and Wallowa Valley, a similar broadening of Wallowa River below the town of Joseph, are important agricultural areas within the Grande Ronde drainage basin. Powder and Palouse rivers and Asotin Creek drain areas similar in character, utilized chiefly for dry farming and the production of wheat. The waters of all of these streams are valuable for irrigation, which in a number of the valleys—notably that of the Malheur—has reached a comparatively high stage of development. At Asotin a power plant is operated, and the waters used for power are also used for irrigation.

NORTH FORK OF SNAKE RIVER NEAR ORA, IDAHO.

This station was established August 20, 1902. It is located at the North Fork Bridge, 2 miles south of Ora and 10 miles above St. Anthony, Idaho. The bench mark is a United States Geological Survey aluminum tablet set in a large rock about 30 feet northeast from the north end of the bridge; elevation, 12.84 feet above the gage datum.

The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 91, where are given also references to publications that contain data for previous years.

Discharge measurements of North Fork of Snake River near Ora, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11	E. C. La Rue	178	505	2.90	2,170
May 27	....do	178	470	2.70	1,900
June 17	....do	178	496	2.85	2,130

Daily gage height, in feet, of North Fork of Snake River near Ora, Idaho, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	2.0	2.0	2.0	1.9	3.3	2.9	2.5	2.1	2.1	2.0	2.1
2	2.0	2.0	2.0	1.9	3.3	2.9	2.5	2.1	2.1	2.0	2.1
3	2.0	2.0	2.0	1.9	3.3	2.8	2.5	2.1	2.1	2.0	2.1
4	2.0	1.9	2.0	1.9	3.3	2.9	2.4	2.1	2.0	2.0	2.1
5	2.0	1.9	1.9	1.9	3.1	3.0	2.4	2.1	2.0	2.0	2.1
6	2.0	1.9	1.9	1.9	3.1	3.2	2.4	2.1	2.0	2.0	2.1
7	2.0	1.9	1.9	1.9	2.9	3.2	2.4	2.1	2.0	2.0	2.1
8	2.0	2.0	1.9	2.0	2.9	3.1	2.4	2.1	2.0	2.1	2.1
9	2.0	2.0	1.9	2.0	2.9	3.0	2.4	2.1	2.1	2.1	2.1
10	2.0	2.0	1.9	2.0	2.8	2.9	2.4	2.0	2.1	2.1	2.1
11	2.0	2.0	1.9	2.1	2.8	2.9	2.4	2.0	2.1	2.1	2.1
12	2.0	2.0	1.9	2.1	2.8	2.8	2.3	2.0	2.1	2.1	2.1
13	2.0	2.0	1.9	2.1	2.8	2.8	2.3	2.0	2.1	2.1	2.1
14	2.0	2.0	1.9	2.1	2.9	2.8	2.3	2.0	2.2	2.1	2.1
15	2.0	2.0	1.9	2.1	2.9	2.8	2.3	2.0	2.2	2.1	2.1
16	2.0	2.0	1.9	2.1	2.9	2.7	2.3	2.0	2.2	2.1	2.1
17	2.0	2.0	1.9	2.2	2.8	2.8	2.3	2.0	2.2	2.1	2.1
18	2.0	2.0	1.9	2.2	2.8	2.8	2.3	2.1	2.2	2.1	2.0
19	2.0	2.0	1.9	2.2	2.7	2.7	2.3	2.1	2.1	2.1	2.0
20	2.0	2.0	1.9	2.2	2.7	2.7	2.3	2.1	2.1	2.1	2.0
21	2.0	2.0	2.0	2.2	2.7	2.6	2.3	2.1	2.1	2.1	2.0
22	2.0	2.0	2.0	2.5	2.6	2.6	2.2	2.2	2.1	2.1	2.0
23	2.0	2.0	2.0	2.5	2.6	2.6	2.2	2.2	2.1	2.1	2.0
24	2.0	2.0	2.0	2.8	2.6	2.6	2.2	2.2	2.1	2.1	2.0
25	2.0	2.0	2.0	3.0	2.7	2.5	2.2	2.2	2.1	2.1	2.0
26	2.0	2.0	2.0	3.0	2.7	2.5	2.2	2.2	2.1	2.1	2.0
27	2.0	2.0	2.0	3.1	2.7	2.5	2.2	2.2	2.1	2.1	2.0
28	2.0	2.0	1.9	3.2	2.7	2.5	2.2	2.1	2.1	2.1	2.0
29	2.0	....	1.9	3.3	2.9	2.5	2.2	2.1	2.1	2.1	2.0
30	2.0	....	1.9	3.3	3.1	2.5	2.1	2.1	2.2	2.1	2.0
31	2.0	....	1.9	....	3.0	....	2.1	2.1	....	2.1	(a)

[a] Record discontinued for the winter.

Rating table for North Fork of Snake River near Ora, Idaho, for 1906.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	910	2.20	1,170	2.50	1,550	2.80	2,030	3.10	2,600
2.00	990	2.30	1,280	2.60	1,700	2.90	2,210	3.20	2,810
2.10	1,070	2.40	1,410	2.70	1,860	3.00	2,400	3.30	3,030

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1905–6 and is well defined.

Monthly discharge of North Fork of Snake River near Ora, Idaho, for 1906.

[Drainage area, 1,040 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	990	990	990	60,900	0.952	1.10
February	990	910	979	54,400	.942	.98
March	990	910	938	57,700	.902	1.04
April	3,030	910	1,430	85,300	1.38	1.54
May	3,030	1,700	2,200	135,000	2.11	2.43
June	2,810	1,550	2,000	119,000	1.92	2.14
July	1,550	1,070	1,300	79,800	1.25	1.44
August	1,170	990	1,070	65,700	1.03	1.19
September	1,170	990	1,080	64,100	1.04	1.16
October	1,070	990	1,050	64,700	1.01	1.16
November	1,070	990	1,030	61,600	.995	1.11
The period				848,000		

NOTE.—Values are rated as excellent on the assumption that the flow was not affected by ice conditions, January to March.

SNAKE RIVER NEAR MINIDOKA, IDAHO.

This station was originally established August 5, 1895, at Montgomery's ferry, on the stage road from Minidoka to Albion, 4 miles east of Rupert, Idaho, and 10 miles below the diversion dam for the Minidoka irrigation project. Measurements at Montgomery's ferry show the amount of water available for irrigation purposes there and for the newly constructed Twin Falls canals heading 23 miles below, and also the conditions that will exist for power purposes at Shoshone Falls, about 45 miles below, after the irrigable lands of Snake River Valley shall have been reclaimed. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 93, where are given also references to publications that contain data for previous years.

Discharge measurements of Snake River near Minidoka, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Dis-charge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 12	E. C. La Rue	815	4,020	3.15	6,120
April 26	do	835	4,980	4.34	9,590
May 19	do	860	6,610	6.29	16,100
June 9	do	865	7,970	7.92	22,500

Daily gage height, in feet, of Snake River near Minidoka, Idaho, in 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	....	2.7	3.4	4.7	7.35	4.4	2.4	2.2	2.65
2	(a)	2.7	3.4	4.7	7.5	4.4	2.25	2.3	2.65
3	3.25	3.0	3.3	4.8	7.7	4.4	2.2	2.35	2.6
4	3.2	2.9	3.15	4.95	7.8	4.4	2.05	2.35	2.7
5	3.2	2.7	3.15	5.1	7.8	4.4	1.9	2.35	2.65
6	3.0	2.7	3.2	5.5	7.85	4.4	1.8	2.35	2.6
7	3.0	2.7	3.1	5.5	7.8	4.4	1.7	.6	2.6
8	2.9	2.7	3.1	5.6	7.85	4.4	1.6	.75	2.6
9	3.05	2.7	3.0	5.55	7.85	4.4	1.6	1.9	2.55
10	3.3	2.7	3.0	5.5	8.0	3.85	1.55	2.1	2.4
11	3.05	2.7	3.0	5.4	8.0	3.35	1.5	2.1	2.35
12	2.7	2.7	3.1	5.4	7.95	3.3	1.5	2.1	2.35
13	2.4	2.65	3.25	5.5	7.85	3.3	1.45	2.1	2.4
14	2.2	2.6	3.25	5.55	7.7	3.2	1.45	2.1	2.4
15	2.35	2.5	3.25	5.75	7.9	3.2	1.45	2.1	2.4
16	2.5	2.35	3.3	5.9	8.0	3.2	1.45	2.1	2.6
17	2.6	2.45	3.2	6.1	8.15	3.4	1.45	2.1	2.95
18	2.6	2.9	3.2	6.25	8.2	4.8	1.45	2.15	2.9
19	2.6	2.8	3.2	6.3	8.3	5.2	1.45	2.2	3.2
20	2.65	2.55	3.25	6.3	8.3	5.1	1.45	2.2	3.4
21	2.7	2.4	3.45	6.25	8.1	5.1	1.45	2.25	3.6
22	2.7	2.35	3.6	6.2	7.8	5.0	1.5	2.25	3.5
23	2.7	2.5	3.7	6.15	7.5	4.75	1.5	2.25	3.35
24	2.75	2.6	4.0	6.2	7.25	4.6	1.5	2.3	3.25
25	2.75	2.8	4.2	6.2	6.85	4.4	1.5	2.4	3.2
26	2.75	3.05	4.3	6.2	6.6	4.15	2.1	2.7	3.2
27	2.7	3.2	4.45	6.2	6.35	4.9	2.45	2.7	3.15
28	2.7	3.3	4.65	6.45	6.05	3.7	2.6	2.7	3.1
29	....	3.3	4.7	6.55	5.4	3.45	2.55	2.7	3.05
30	....	3.4	4.7	6.8	4.75	3.1	2.2	2.65	3.0
31	....	3.4	....	7.05	....	2.7	2.2	....	(b)

[a] River frozen over January 1 to February 2, 1906.

[b] Gates at Minidoka dam were closed during November. Records at gaging station were unreliable November 1 to December 31.

Rating table for Snake River near Minidoka, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	1,640	1.70	2,670	2.70	4,930	3.70	7,630	5.40	12,950
.70	1,680	1.80	2,860	2.80	5,180	3.80	7,920	5.60	13,670
.80	1,720	1.90	3,060	2.90	5,440	3.90	8,210	5.80	14,390
.90	1,760	2.00	3,270	3.00	5,700	4.00	8,500	6.00	15,110
1.00	1,820	2.10	3,480	3.10	5,970	4.20	9,080	6.20	15,830
1.10	1,880	2.20	3,700	3.20	6,240	4.40	9,680	6.40	16,550
1.20	1,960	2.30	3,940	3.30	6,510	4.60	10,280	6.60	17,270
1.30	2,060	2.40	4,180	3.40	6,780	4.80	10,890	6.80	18,010
1.40	2,190	2.50	4,430	3.50	7,060	5.00	11,540	7.00	18,790
1.50	2,340	2.60	4,680	3.60	7,340	5.20	12,230	8.00	23,010
1.60	2,500								

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905-6 and is well defined above 2.3 feet; below that it is uncertain.

Monthly discharge of Snake River near Minidoka, Idaho, for 1906.

[Drainage area, 17,900 [a] square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec. ft. per sq. mile.	Depth in inches.
February (3-28)	6,510	3,700	5,150	265,000	0.288	0.28
March	6,780	4,060	5,130	316,000	.287	.33
April	10,600	5,700	7,150	425,000	.399	.44
May	19,000	10,600	14,500	892,000	.810	.93
June	24,300	10,700	20,900	1,250,000	1.17	1.30
July	12,200	4,930	8,870	546,000	.496	.57
August	4,680	2,260	2,900	178,000	.162	.19
September	4,930	1,640	3,770	225,000	.211	.23
October	7,340	4,060	5,320	317,000	.297	.33
The period	....	....	....	4,410,000	....	....

[a] Exclusive of drainage of Big and Little Lost rivers.

NOTE.—Values are rated as follows: February to July, and October, excellent; August and September, good.

SNAKE RIVER BETWEEN MILNER DAM AND SHOSHONE FALLS, DURING NOVEMBER, 1906.

The following is a brief report of investigations in regard to the source and volume of flow in Snake River between the Milner dam, Milner, Idaho, and Shoshone Falls, Idaho, dating from November 14 to 22 (inclusive), 1906, when the flow was entirely cut off at the Minidoka dam.

The flow at this time below the Milner dam was derived from leakage through the gates at the dam, waste water from the Twin Falls tract, and springs along its course. In no case did water flow over the Milner dam and the waste from the Twin Falls tract was at a minimum

In passing down the river from Milner to Shoshone Falls, discharge measurements were made as often as suitable stations could be found. All springs of appreciable size entering between Milner and Shoshone Falls lie between Shoshone Falls and a point 6 miles above. Most of them enter on the north side. The source of these springs is not definitely known. Upon them will depend the permanent flow of Snake River over Shoshone Falls at future times if all the water is diverted above for irrigation, with no waste.

The following is a tabulation of the measurements taken:

Measurements between Milner Dam and Shoshone Falls in 1906.

Date.	Location.		Discharge.	Date.	Location.		Discharge.
	Above Shoshone Falls.	Below Milner.			Above Shoshone Falls.	Below Milner.	
	Feet.	*Miles.*	*Sec.-ft.*		*Feet.*	*Miles.*	*Sec.-ft.*
November 14	1,500	....	195	November 18	....	6	20
November 15	1,500	....	165	November 18	....	7	27
November 16	1,500	....	158	November 20	....	16	60
November 17	....	2	22	November 21	1,500	....	169
November 18	....	4	17	November 22	1,500	....	200

During the investigation the minimum flow measured at Shoshone Falls was 158 second-feet. The measurements made between the Milner dam and a point 7 miles below show that about 30 second-feet come from leakage through the Milner dam and waste from the Twin Falls tract; there then remains 128 second-feet as the gain in discharge between Milner dam and Shoshone Falls. Just what part of this is spring water and what part drains from pools can not be determined. Throughout the course there are a great many pools from 200 feet to 1 mile in length. No doubt it would take considerable time for these pools to drain down to a normal stage.

There is but one conclusion to be drawn and that is that the permanent flow over Shoshone Falls during the irrigation season, when the water is all diverted above, will be reduced to approximately 130 second-feet or less.

SNAKE RIVER AT NEELEY, IDAHO.

On March 17, 1906, a temporary station was established at Neeley, Idaho, 3 miles above the backwater from the Minidoka dam and 4 miles below American Falls. This station is to eventually take the place of the old Montgomery station below the Minidoka dam. During 1906 only gage readings were taken. The station will be rated at some future time.

Daily gage height, in feet, of Snake River at Neeley, Idaho, for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	5.3	6.8	9.8	6.65	....	4.9	....	4.9	5.0
2	....	5.25	7.0	9.7	6.5	4.2	4.8	....	4.9	5.0
3	....	5.25	7.5	9.65	6.4	....	4.65	....	4.9	5.0
4	....	5.2	7.1	9.4	6.5	4.0	4.5	4.6	5.0	5.0
5	....	5.15	7.15	9.4	6.65	4.0	4.5	4.6	5.0	5.0
6	....	5.15	7.35	9.3	6.7	3.9	4.6	4.6	5.0	(a)
7	....	5.1	7.6	9.5	0.6	3.8	6.5	4.7	5.0	....
8	....	5.05	7.4	9.7	6.5	3.8	6.3	4.7	5.0	....
9	....	5.05	7.25	9.75	6.4	3.75	5.0	4.7	5.0	....
10	....	5.1	7.15	9.5	6.4	3.7	4.3	4.7	5.0	....
11	....	5.25	7.1	9.3	6.3	3.7	4.3	4.7	5.0	....
12	....	5.4	7.4	9.0	6.3	3.7	4.35	4.7	5.0	....
13	....	5.35	7.65	9.1	6.3	3.7	4.4	4.7	5.0	....
14	....	5.3	7.85	9.5	6.3	3.7	4.5	4.7	5.0	....
15	....	5.15	8.2	9.7	6.3	3.7	4.5	4.8	5.0	....
16	....	5.1	8.5	10.0	6.3	3.7	4.5	4.8	5.0	....
17	4.55	5.2	8.6	9.85	6.2	3.7	4.6	4.8	5.0	....
18	4.55	5.3	8.7	9.75	6.1	3.7	4.7	4.8	5.0	....
19	4.55	5.4	8.3	9.65	6.0	3.7	4.75	4.8	5.0	....
20	4.6	5.45	8.0	9.5	6.0	3.65	4.8	4.8	5.0	....
21	4.65	5.8	7.6	8.9	5.9	3.65	4.8	4.8	5.0	....
22	4.7	5.95	7.75	8.0	5.8	3.65	4.8	4.8	5.0	....
23	4.7	6.05	7.9	7.7	5.7	3.7	4.7	4.9	5.0	....
24	4.95	6.35	7.8	7.5	5.6	3.8	4.7	4.9	5.0	....
25	5.2	6.7	7.95	7.3	5.5	4.1	4.7	4.9	5.0	....
26	5.35	6.9	8.1	7.0	5.4	4.6	4.7	4.9	5.0	....
27	5.6	6.85	8.65	6.7	5.2	4.95	4.7	4.9	5.0	....
28	5.45	6.8	9.2	6.6	....	4.95	4.0	4.9	5.0	....
29	5.35	6.75	9.4	6.5	....	4.95	4.6	4.9	5.0	....
30	5.35	6.65	9.5	6.7	....	4.95	4.5	4.9	5.0	....
31	5.45	....	9.9	....	....	4.9	....	4.9	....	....

[a] Record discontinued for the winter.

FALL RIVER AT FREMONT, IDAHO.

This station was established January 1, 1904, about 900 feet from Fremont post-office. During 1906 the gage was read once each day by Mrs. Eva A. Loomis and C. R. Scheetz. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 97, where are given also references to publications that contain data for previous years.

Discharge measurements of Fall River at Fremont, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11	E. C. La Rue	147	362	3.25	1.640
May 27	do	148	369	3.32	1,690
June 17	do	149	448	3.85	2.510
August 17	do	140	184	2.02	468

Daily gage height, in feet, of Fall River at Fremont, Idaho, for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	....	2.8	3.5	3.1	1.9	1.9	1.9	1.9
2	....	2.1	3.6	3.2	2.0	1.9	1.9	1.9
3	....	2.1	3.55	3.0	2.05	1.9	1.95	1.9
4	....	2.1	3.4	3.0	2.05	1.9	1.95	1.9
5	....	2.9	3.85	3.1	2.0	1.95	1.95	1.9
6	([a])	2.1	3.95	3.3	2.0	1.8	1.95	1.9
7	1.9	2.1	3.8	3.1	2.0	1.9	1.9	1.9
8	1.9	2.1	3.65	3.0	2.0	1.9	1.9	1.9
9	1.9	3.0	3.3	3.0	2.0	1.9	1.9	1.9
10	1.9	3.0	3.0	3.1	2.0	1.9	1.9	1.9
11	1.9	3.1	3.4	3.1	2.0	1.9	1.9	1.9
12	1.9	3.2	3.3	3.0	2.0	1.9	1.9	1.9
13	1.9	3.1	3.55	2.9	2.0	1.9	1.95	1.9
14	1.9	3.3	3.65	2.8	2.05	1.95	1.95	1.9
15	1.9	3.8	3.5	2.6	2.05	2.05	1.95	1.9
16	1.9	3.4	3.3	2.6	2.0	1.95	1.95	1.9
17	2.0	2.9	3.95	2.6	2.0	1.9	1.95	1.9
18	2.05	2.85	3.55	2.5	2.0	1.9	1.95	([b])
19	2.1	2.95	3.3	2.3	2.05	1.9	1.95	....
20	2.1	2.1	3.1	2.3	2.05	1.9	1.95	....
21	2.15	2.1	3.0	2.5	2.0	1.9	1.9	....
22	2.25	3.0	3.0	2.4	2.0	1.9	1.9	....
23	2.45	3.1	3.0	2.3	2.1	1.95	1.9	....
24	2.65	3.4	3.0	2.2	2.15	1.9	1.9	....
25	2.6	3.65	3.0	2.3	2.05	1.9	1.9	....
26	2.5	3.5	2.9	2.3	2.0	1.9	1.9	....
27	2.5	3.5	3.1	2.2	2.05	1.9	1.9	....
28	2.55	3.55	3.25	2.0	2.0	1.9	1.9	....
29	2.7	3.6	3.0	1.9	1.9	1.9	1.9	....
30	2.8	3.45	3.3	1.9	1.9	1.9	1.9	....
31	....	3.5	....	2.0	1.9	....	1.9	....

[a] No record on account of ice January 1 to April 6, 1906.
[b] Record discontinued for the winter on November 18.

Rating table for Fall River at Fremont, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	168	2.00	485	2.60	945	3.20	1,565	3.80	2,345
1.50	210	2.10	555	2.70	1,035	3.30	1,685	3.90	2,495
1.60	255	2.20	625	2.80	1,125	3.40	1,815	4.00	2,655
1.70	305	2.30	700	2.90	1,225	3.50	1,945		
1.80	365	2.40	775	3.00	1,335	3.60	2,075		
1.90	425	2.50	860	3.10	1,445	3.70	2,205		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1905–6 and is well defined.

Monthly discharge of Fall River at Fremont, Idaho, for 1906.

[Drainage area, 390 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April 7–30	1,120	425	631	30,000	1.62	1.45
May	2,340	555	1,350	83,200	3.47	4.00
June	2,580	1,220	1,780	105,800	4.56	5.09
July	1,680	425	1,010	62,300	2.60	3.00
August	590	425	492	30,200	1.26	1.45
September	520	365	430	25,600	1.10	1.23
October	455	425	437	26,900	1.12	1.29
November 1–17	425	425	425	14,300	1.09	.69
The period				378,000		

NOTE.—Values are rated as follows: May to July, excellent; April and August to November, good.

TETON RIVER NEAR ST. ANTHONY, IDAHO.

This station was established April 23, 1903. It is located at the bridge on the stage road from St. Anthony to Victor, Idaho. The bench mark is a United States Geological Survey aluminum tablet set in solid rock about 30 feet northeast of the north end of the bridge; elevation, 13.53 feet above the gage datum. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 99, where are given also references to publications that contain data for previous years.

Discharge measurements of Teton River near St. Anthony, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 12	E. C. La Rue	79.5	438	3.20	1,640
May 28	do	79.5	477	3.65	2,100
June 18	do	79.5	498	3.90	2,270
August 13	do	79.5	350	1.95	646

Daily gage height, in feet, of Teton River near St. Anthony, Idaho, for 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.3	1.6	2.0	3.65	2.65	2.05	1.8	1.75	1.7	1.6
2		1.35	1.5	2.1	3.55	2.8	2.05	1.75	1.75	1.7	1.6
3		1.35	1.6	2.15	3.5	2.95	2.05	1.75	1.85	1.7	1.7
4		1.3	1.6	2.3	3.9	3.0	2.05	1.75	1.85	1.7	1.8
5		1.35	1.65	2.4	3.1	3.0	2.1	1.8	1.8	1.7	1.8
6		1.35	1.7	2.3	4.25	2.95	2.05	1.8	1.8	1.75	1.7
7		1.3	1.9	2.25	4.1	2.95	2.05	1.8	1.75	1.75	1.65
8		1.3	2.0	2.3	3.8	2.85	2.05	1.8	1.75	1.65	1.6
9		1.3	2.1	2.5	3.5	2.95	2.05	1.8	1.7	1.65	(a)
10		1.3	2.15	2.85	3.45	2.85	2.0	1.8	1.7	1.65	
11		1.1	2.2	3.0	3.9	2.8	2.0	1.8	1.7	1.65	
12		1.0	2.15	3.3	4.25	2.75	1.9	1.8	1.7	1.65	
13		1.2	2.1	3.4	4.9	2.75	1.9	1.8	1.7	1.65	
14		1.3	2.0	3.6	4.95	2.7	1.85	1.85	1.75	1.65	
15		1.4	2.1	3.85	4.35	2.65	1.85	1.95	1.75	1.6	
16		1.2	2.25	3.7	4.2	2.6	1.85	2.0	1.7	1.6	
17		1.2	2.45	3.2	4.15	2.6	1.85	2.0	1.75	1.6	
18		1.1	2.35	2.85	3.9	2.6	1.8	1.9	1.75	1.6	
19	1.3	1.1	2.15	2.6	3.45	2.55	1.85	1.9	1.75	1.65	
20	1.3	1.1	2.1	2.8	3.0	2.5	1.9	1.8	1.75	1.7	
21	1.25	1.1	2.0	3.0	2.9	2.35	1.95	1.8	1.75	1.65	
22	1.3	1.2	2.1	3.1	2.95	2.4	1.9	1.8	1.7	1.6	
23	1.3	1.25	2.2	2.95	2.9	2.4	1.95	1.8	1.7	1.65	
24	1.3	1.3	2.3	3.15	2.8	2.4	2.0	1.8	1.7	1.65	
25	1.3	1.3	2.35	4.1	2.65	2.3	2.0	1.8	1.7	1.6	
26	1.3	1.35	2.15	4.5	2.7	2.25	2.0	1.8	1.7	1.6	
27	1.35	1.35	2.0	3.95	2.7	2.2	1.95	1.75	1.7	1.6	
28	1.35	1.4	1.9	3.6	2.75	2.1	1.9	1.75	1.7	1.6	
29		1.5	1.9	3.95	2.9	2.1	1.9	1.75	1.7	1.6	
30		1.6	1.95	3.1	2.65	2.1	1.85	1.75	1.7	1.6	
31		1.65		3.8		2.1	1.8		1.7		

[a] Discontinued for the winter.

Rating table for Teton River near St. Anthony, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	88	1.80	548	2.60	1,100	3.40	1,755	4.40	3,045
1.10	142	1.90	610	2.70	1,177	3.50	1,850	4.60	3,385
1.20	197	2.00	674	2.80	1,255	3.60	1,950	4.80	3,740
1.30	253	2.10	740	2.90	1,335	3.70	2,060	5.00	4,115
1.40	310	2.20	808	3.00	1,417	3.80	2,175		
1.50	368	2.30	878	3.10	1,500	3.90	2,300		
1.60	427	2.40	950	3.20	1,584	4.00	2,435		
1.70	487	2.50	1,024	3.30	1,669	4.20	2,730		

NOTE.—The above table is strictly applicable only for open-channel conditions. It is based on 14 discharge measurements made during 1904–1906 and is well defined above gage height 1.5 feet.

Monthly discharge of Teton River near St. Anthony, Idaho, for 1906.

[Drainage area, 960 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
February 19–28	281	225	256	5,080	0.267	0.10
March	457	88	247	15,200	.257	.30
April	987	368	690	41,100	.719	.80
May	3,220	674	1,520	93,700	1.59	1.83
June	4,020	1,140	2,010	119,000	2.09	2.33
July	1,420	740	1,100	67,400	1.14	1.31
August	740	548	643	39,500	.670	.77
September	674	517	557	33,100	.580	.65
October	579	487	508	31,200	.529	.61
November	517	427	456	27,100	.475	.53
December 1–8	548	427	476	7,550	.496	.15
The period				480,000		

NOTE.—Values are rated as follows: February and March, good; April to December, excellent.

SOUTH FORK OF SNAKE RIVER AT MORAN, WYO.

This station was established September 21, 1903. It is located directly back of the post-office at Moran, Wyo., and about three-fourths mile below the outlet of Jackson Lake. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 101, where are given also references to publications that contain data for previous years.

Discharge measurements of South Fork of Snake River at Moran, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 19	R. J. Newell	202	1,190	5.52	5,740
June 24	do	202	1,030	4.70	4,290
August 25	E. C. La Rue	198	520	1.85	962

Daily gage height, in feet, of South Fork of Snake River at Moran, Wyo., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	1.0	1.2	1.25	1.2	1.7	4.7	4.4	2.7	1.7	1.25
2	1.0	1.2	1.25	1.2	1.75	4.7	4.3	2.65	1.7	1.25
3	1.0	1.2	1.2	1.2	1.8	4.7	4.3	2.6	1.65	1.25
4	1.0	1.15	1.2	1.2	1.85	4.6	4.25	2.5	1.65	1.25
5	1.0	1.15	1.2	1.2	1.9	4.4	4.25	2.5	1.65	1.2
6	1.0	1.15	1.2	1.2	1.95	4.6	4.25	2.45	1.65	1.2
7	1.0	1.1	1.2	1.2	2.0	4.8	4.25	2.4	1.65	1.2
8	1.0	1.1	1.2	1.2	2.05	4.75	4.25	2.35	1.65	1.2
9	.9	1.1	1.2	1.2	2.15	4.7	4.25	2.15	1.6	1.15
10	.9	1.1	1.2	1.2	2.25	4.8	4.25	1.95	1.6	1.15
11	.9	1.15	1.2	1.2	2.35	4.85	4.2	1.95	1.55	1.1
12	.9	1.15	1.2	1.2	2.55	4.9	4.2	1.9	1.55	1.1
13	.9	1.15	1.2	1.2	2.8	5.0	3.95	1.9	1.5	(a)
14	.9	1.15	1.2	1.2	3.15	5.1	3.95	1.95	1.5	....
15	.9	1.15	1.2	1.2	3.45	5.25	3.8	1.95	1.45	....
16	.9	1.15	1.2	1.2	3.55	5.65	3.85	1.9	1.45	....
17	1.0	1.15	1.2	1.2	3.6	5.65	3.7	1.85	1.4	....
18	1.0	1.15	1.2	1.2	3.6	5.65	3.65	1.8	1.4	....
19	1.1	1.2	1.2	1.2	3.65	5.45	3.6	1.8	1.4	....
20	1.1	1.2	1.2	1.2	3.7	5.2	3.5	1.8	1.4	....
21	1.15	1.2	1.2	1.2	3.8	5.1	3.55	1.8	1.4	....
22	1.15	1.2	1.2	1.25	3.95	4.9	3.4	1.85	1.4	....
23	1.2	1.2	1.2	1.3	4.1	4.8	3.35	1.85	1.35	....
24	1.2	1.2	1.2	1.3	4.25	4.65	3.2	1.85	1.35	....
25	1.2	1.2	1.2	1.35	4.5	4.55	3.2	1.85	1.3	....
26	1.2	1.2	1.2	1.4	4.6	4.5	3.1	1.85	1.3	....
27	1.2	1.2	1.2	1.45	4.65	4.45	2.95	1.85	1.3	....
28	1.2	1.2	1.2	1.5	4.8	4.45	2.8	1.8	1.3	....
29	1.2	....	1.2	1.6	5.0	4.4	2.8	1.8	1.3	....
30	1.2	....	1.2	1.65	5.0	4.35	2.8	1.75	1.3	....
31	1.2	....	1.2	....	4.85	....	2.75	1.75	....	....

[a] Water shut off of Jackson Lake Dam October 13 to December 24, 1906.

Rating table for South Fork of Snake River at Moran, Wyo., for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.80	330	1.90	1,007	3.00	1,967	4.10	3,280	5.20	5,080
0.90	374	2.00	1,084	3.10	2,070	4.20	3,420	5.30	5,265
1.00	422	2.10	1,163	3.20	2,175	4.30	3,565	5.40	5,450
1.10	474	2.20	1,244	3.30	2,285	4.40	3,715	5.50	5,640
1.20	530	2.30	1,327	3.40	2,400	4.50	3,870	5.60	5,830
1.30	590	2.40	1,412	3.50	2,515	4.60	4,030	5.70	6,025
1.40	653	2.50	1,499	3.60	2,635	4.70	4,195	5.80	6,220
1.50	719	2.60	1,588	3.70	2,760	4.80	4,365		
1.60	788	2.70	1,679	3.80	2,885	4.90	4,540		
1.70	859	2.80	1,772	3.90	3,015	5.00	4,720		
1.80	932	2.90	1,868	4.00	3,145	5.10	4,900		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 9 discharg measurements made during 1903–1906 and is well defined.

Monthly discharge of South Fork of Snake River at Moran, Wyo., for 1906.

[Drainage area, 820 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	530	374	449	27,600	0.548	0.63
February	530	474	511	28,380	.623	.65
March	560	530	532	32,700	.649	.75
April	823	530	572	34,000	.698	.78
May	4,720	859	2,450	151,000	2.99	3.45
June	5,930	3,640	4,480	267,000	5.46	6.09
July	3,720	1,720	2,820	173,000	3.44	3.97
August	1,680	895	1,120	68,800	1.36	1.57
September	859	590	708	42,100	.863	.96
October 1–12	560	474	526	12,500	.641	.29
The period	....	....	....	837,000	....	....

NOTE.—Values are rated as follows: January to April, September, and October, good; May to August, excellent. Flow assumed unaffected by ice conditions.

SOUTH FORK OF SNAKE RIVER NEAR LYON, IDAHO.

This station was established April 18, 1903. It is located on the old site of Wedekind's Ferry, between Lyon and Swan Valley, at the upper end of Conant Valley. It is about 45 miles from Idaho Falls, Idaho. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 103, where are given also references to publications that contain data for previous years.

Discharge measurements of South Fork of Snake River near Lyon, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 21	E. C. La Rue	292	2,370	5.80	16,900
June 11	do	295	2,580	6.45	19,500
June 12	do	299	2,670	6.85	20,600

Daily gage height, in feet, of South Fork of Snake River near Lyon, Idaho, for 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.05	0.95	3.5	6.55	5.25	3.35	2.2	1.65	1.25
2		1.05	1.1	3.6	6.3	5.6	3.25	2.2	1.6	1.2
3		1.0	1.1	3.7	6.2	5.7	3.25	2.1	1.6	1.2
4		.9	.95	4.3	6.35	5.7	3.2	2.1	1.65	1.25
5		.8	.9	4.4	6.65	5.6	3.1	2.05	1.65	1.25
6		.7	.9	4.0	6.9	5.65	3.05	2.05	1.6	1.2
7		.7	.95	3.85	6.7	5.6	3.0	2.0	1.6	1.2
8		.7	1.2	4.0	6.3	5.5	2.9	2.0	1.6	1.2
9		.7	1.35	4.3	6.1	5.4	2.8	2.0	1.55	1.2
10		.7	1.45	4.65	6.1	5.35	2.7	2.0	1.55	1.2
11		.7	1.6	5.0	6.4	5.3	2.6	1.95	1.55	1.2
12		.4	1.6	5.2	7.0	5.2	2.5	1.95	1.6	1.2
13		.4	1.6	5.55	7.7	5.16	2.55	1.9	1.55	1.2
14		.6	1.5	6.16	7.9	5.2	2.55	1.95	1.5	1.6
15		.6	1.6	6.4	7.6	5.0	2.6	2.0	1.45	1.7
16		.6	1.8	6.2	7.5	4.8	2.4	1.95	1.4	1.55
17		.6	2.1	5.5	7.4	4.7	2.35	1.9	1.4	1.4
18	(a)	.6	2.4	5.16	7.1	4.7	2.35	1.9	1.3	1.2
19	1.7	.7	2.6	5.05	6.6	4.65	2.4	1.85	1.3	1.1
20	1.3	.7	2.6	5.35	6.2	4.4	2.6	1.85	1.25	.9
21	1.4	.8	2.85	5.8	6.0	4.3	2.6	1.8	1.2	.9
22	1.4	.8	3.2	5.7	6.0	4.3	2.8	1.8	1.2	.65
23	1.3	.8	3.6	5.7	5.95	4.3	2.9	1.75	1.3	.55
24	1.2	.8	3.7	6.35	5.65	4.2	2.85	1.75	1.25	.75
25	1.15	.9	3.55	7.2	6.6	4.05	2.7	1.75	1.3	.9
26	1.1	.9	3.2	7.16	5.4	3.9	2.6	1.7	1.3	.9
27	1.1	.9	3.0	6.9	5.6	3.8	2.6	1.7	1.25	.8
28	1.05	.9	3.0	7.25	5.7	3.65	2.4	1.7	1.25	.76
29		.9	3.2	7.55	5.55	3.6	2.3	1.65	1.25	.75
30		.9	3.6	7.15	5.2	3.4	2.3	1.65	1.25	.6
31		.95		6.9		3.3	2.2		1.25	(b)

[a] Frozen over, January 1 to February 18.
[b] December 1, record discontinued for the winter.

Rating table for South Fork of Snake River near Lyon, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	1,700	1.50	3,000	2.60	5,090	3.70	7,850	5.40	14,160
0.50	1,800	1.60	3,155	2.70	5,310	3.80	8,150	5.60	15,010
0.60	1,900	1.70	3,320	2.80	5,530	3.90	8,450	5.80	15,900
0.70	2,005	1.80	3,495	2.90	5,750	4.00	8,760	6.00	16,830
0.80	2,115	1.90	3,680	3.00	5,980	4.20	9,420	6.20	17,790
0.90	2,225	2.00	3,870	3.10	6,220	4.40	10,150	6.40	18,760
1.00	2,340	2.10	4,065	3.20	6,470	4.60	10,920	6.60	19,750
1.10	2,460	2.20	4,265	3.30	6,730	4.80	11,710	6.80	20,750
1.20	2,585	2.30	4,465	3.40	7,000	5.00	12,520	7.00	21,760
1.30	2,715	2.40	4,670	3.50	7,208	5.20	13,340	8.00	27,060
1.40	2,855	2.50	4,880	3.60	7,560				

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906 and is well defined.

Monthly discharge of South Fork of Snake River near Lyon, Idaho, for 1906.

[Drainage area, 5,480 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
February (19-28)	3,320	2,400	2,690	53,300	0.491	0.18
March	2,400	1,700	2,080	128,000	.379	.44
April	7,850	2,220	4,300	256,000	.786	.88
May	24,600	7,280	14,900	915,000	2.72	3.14
June	26,500	13,300	18,900	1,120,000	3.44	3.84
July	15,400	6,730	11,700	718,000	2.13	2.46
August	6,860	4,260	5,320	327,000	.970	1.12
September	4,260	3,240	3,700	220,000	.675	.75
October	3,240	2,580	2,890	178,000	.528	.61
November	3,320	1,850	2,470	147,000	.450	.50
The period				4,070,000		

NOTE.—Values for 1906 are excellent.

BUFFALO RIVER NEAR ELK, WYO.

On July 31, 1906, a temporary station was established at the wagon bridge on Buffalo River, 300 feet above its junction with South Fork of Snake River.

The gage is a vertical staff nailed to the middle pier of the bridge and was read by the Government engineers during the construction of the temporary dam at Jackson Lake.

Discharge measurements of Buffalo River near Elk, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 14	W. G. Davies	74	218	4.43	352
August 25	E. C. La Rue	74.5	199	4.48	370

Daily gage height, in feet, of Buffalo River near Elk, Wyo., in 1906.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	....	4.8	4.15	4.6	3.9	17	....	4.3	4.1	3.9	4.6
2	....	4.75	4.15	4.0	3.9	18	....	4.25	4.1	4.0	4.6
3	....	4.75	4.1	4.0	3.9	19	....	4.35	4.1	4.6	4.0
4	....	4.8	4.1	4.6	3.9	20	....	4.45	4.1	4.0	4.6
5	....	4.7	4.1	4.6	3.9	21	....	4.5	4.1	4.6	(a)
6	....	4.6	4.1	4.6	3.9	22	....	4.55	4.1	4.0	....
7	....	4.6	4.1	4.0	3.9	23	....	4.6	4.1	4.6	....
8	....	4.55	4.1	4.0	3.9	24	....	4.55	4.1	4.6	....
9	....	4.5	4.1	4.6	3.9	25	....	4.5	4.1	3.9	....
10	....	4.4	4.05	3.9	3.9	26	....	4.4	4.0	3.9	....
11	....	4.4	4.05	3.9	4.6	27	....	4.35	4.6	3.9	....
12	....	4.45	4.05	3.9	4.6	28	....	4.3	4.6	3.9	....
13	....	4.5	4.1	3.9	4.0	29	....	4.25	4.0	3.9	....
14	....	4.5	4.1	3.9	4.0	30	....	4.2	4.6	3.9	....
15	....	4.4	4.1	3.9	4.0	31	4.8	4.2	....	3.9	....
16	....	4.3	4.1	3.9	4.6						

[a] Record discontinued for the winter.

PACIFIC CREEK NEAR MORAN, WYO.

On July 31, 1906, a temporary station was established at the wagon bridge on Pacific Creek, 500 feet above its junction with South Fork of Snake River.

The gage is a vertical staff nailed to the right abutment pier of the bridge. The gage readings were taken by the Government engineers during the construction of the temporary storage dam at Jackson Lake.

Discharge measurements of Pacific Creek near Moran, Wyo., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 14	W. G. Davies	31	90	6.45	96
August 25	E. C. La Rue	29	77	6.60	103

Daily gage height, in feet, of Pacific Creek near Moran, Wyo., for 1906.

Day.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.
1	6.65	6.3	6.2	6.15	17	....	6.35	6.3	6.2
2	6.65	6.3	6.2	6.15	18	....	6.3	6.3	6.25
3	6.7	6.3	6.15	6.15	19	....	6.4	6.3	6.25
4	6.8	6.3	6.15	6.15	20	....	6.5	6.3	6.25
5	6.7	6.3	6.15	6.15	21	....	6.5	6.3	6.2
6	6.6	6.3	6.15	6.15	22	....	6.6	6.3	6.2
7	6.6	6.3	6.15	6.15	23	....	6.65	6.25	6.2
8	6.6	6.3	6.1	6.15	24	....	6.65	6.25	6.2
9	6.55	6.3	6.1	6.15	25	....	6.55	6.25	6.2
16	6.5	6.3	6.1	6.15	26	....	6.5	6.25	6.2
11	6.45	6.25	6.1	6.15	27	....	6.45	6.25	6.2
12	6.45	6.25	6.05	(a)	28	....	6.45	6.2	6.2
13	6.45	6.3	6.05	....	29	....	6.4	6.2	6.2
14	6.45	6.3	6.05	....	30	....	6.35	6.2	6.2
15	6.4	6.3	6.1	....	31	6.7	6.35	....	6.2
16	6.35	6.3	6.15	....					

[a] Record discontinued for the winter.

BLACKFOOT RIVER NEAR PRESTO, IDAHO.

This station was established April 17, 1903. It is located on the ranch of James Just, 2 miles west of Presto and about 15 miles from Blackfoot, Idaho. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 106, where are given also references to publications that contain data for previous years.

Discharge measurements of Blackfoot River near Presto, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 6	E. C. La Rue	56	293	4.06	939
May 20	do	56	288	4.04	932
June 10	do	56	254	3.40	759
August 5	do	53	111	.05	94

Daily gage height, in feet, of Blackfoot River near Presto, Idaho, for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		0.8	4.45	4.1	1.2	0.1	0.5	0.75	1.0
2		.85	4.3	4.15	1.2	.05	.45	.75	.95
3		.8	4.2	4.05	1.25	.05	.5	.8	1.0
4		.9	4.15	4.1	1.2	.05	.5	.75	1.0
5		.95	4.15	4.1	1.15	.05	.5	.8	1.05
6		.9	4.05	3.95	1.1	.05	.7	.8	1.05
7		.9	4.0	3.75	1.0	.0	.6	.8	.95
8	0.7	.85	3.9	3.6	.95	.0	.6	.8	.95
9	.8	.9	3.65	3.5	.9	.05	.55	.75	1.0
10	.6	.7	3.4	3.35	.9	.1	.55	.7	1.0
11	.7	.95	3.15	3.2	.9	.1	.5	.8	1.0
12	.7	1.0	3.0	3.0	.7	.15	.55	.8	1.1
13	.6	.9	2.75	2.7	.65	.4	.6	.8	1.05
14	.6	.95	2.9	2.5	.65	.2	.6	.9	1.0
15	.7	1.4	3.45	2.35	.6	.2	.55	.8	1.05
16	.8	1.5	3.75	2.2	.5	.2	.5	.85	1.05
17	.8	1.7	3.55	2.05	.55	.25	.6	.9	1.1
18	.9	1.95	3.7	2.0	.55	.3	.6	.85	1.15
19	.8	2.5	4.0	2.0	.4	.35	7	.85	1.1
20	.75	2.85	4.1	1.85	.35	.3	.75	.9	1.3
21	.7	3.3	3.8	1.7	.3	.3	.75	.9	1.45
22	.7	4.1	3.55	1.8	.2	35	.75	1.0	1.4
23	.9	5.1	3.3	1.75	.15	.3	.8	.95	1.5
24	1.7	5.5	2.9	1.7	.15	.3	.8	1.0	1.6
25	.85	5.5	2.95	1.55	.15	.35	.7	.9	1.6
26	.7	5.35	2.8	1.5	.1	.4	.65	.9	1.55
27	.75	5.1	2.9	1.4	.15	.45	.65	.95	1.6
28	.8	5.0	3.3	1.4	.1	.45	.7	.9	1.6
29	.8	4.7	3.55	1.25	.1	.5	.7	.9	1.9
30	.75	4.5	3.7	1.15	.1	.5	.7	.9	1.9
31	.9		3.8		.1	.5		.95	

Rating table for Blackfoot River near Presto, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	59	0.90	182	1.80	345	2.70	548	4.20	995
.10	70	1.00	199	1.90	365	2.80	573	4.40	1,070
.20	82	1.10	216	2.00	386	2.90	598	4.60	1,150
.30	94	1.20	233	2.10	407	3.00	624	4.80	1,250
.40	107	1.30	251	2.20	429	3.20	679	5.00	1,350
.50	121	1.40	269	2.30	451	3.40	738	5.20	1,450
.60	135	1.50	287	2.40	474	3.60	798	5.40	1,570
.70	150	1.60	306	2.50	498	3.80	858		
.80	166	1.70	325	2.60	523	4.00	925		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906 and is well defined.

Monthly discharge of Blackfoot River near Presto, Idaho, for 1906.

[Drainage area, 1,020 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
March 8-31	325	135	165	7,860	0.162	0.14
April	1,630	150	593	35,300	.584	.65
May	1,090	560	801	49,200	.788	.91
June	977	224	551	32,800	.542	.60
July	242	70	139	8,550	.137	.16
August	121	59	87	5,350	.086	.10
September	166	114	138	8,210	.136	.15
October	199	150	174	10,700	.171	.20
November	365	190	240	14,300	.236	.26
The period				172,000		

NOTE.—Values are rated as follows: April to June, excellent; March, July, and September to November, good; August, fair.

BIG LOST RIVER NEAR MACKAY, IDAHO.

This station was established November 12, 1903, and was discontinued September 1, 1906. It is located 3½ miles above Mackay, Idaho, above "The Narrows." The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 108, where are given also references to publications that contain data for previous years.

Discharge measurements of Big Lost River near Mackay, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 21	E. C. La Rue	36	84	2.60	140
May 8	do	38	105	3.17	267
May 24	do	42	134	3.95	498
June 14	do	90	298	6.25	1,470
August 7	do	40	108	3.20	324

Daily gage height, in feet, of Big Lost River near Mackay, Idaho, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1	2.7	2.65	2.65	2.65	2.65	4.1	4.7	3.5
2	2.7	2.65	2.65	2.65	2.65	4.05	4.65	3.5
3	2.7	2.65	2.65	2.65	2.65	4.0	5.05	3.45
4	2.7	2.65	2.65	2.65	2.65	4.2	5.3	3.4
5	2.7	2.65	2.6	2.65	2.8	4.6	5.4	3.3
6	2.7	2.65	2.6	2.65	2.9	4.6	5.6	3.25
7	2.7	2.65	2.6	2.7	3.1	4.5	5.5	3.15
8	2.7	2.65	2.6	2.7	3.3	4.25	5.4	3.1
9	2.7	2.65	2.6	2.7	3.55	4.2	5.4	3.05
10	2.7	2.65	2.6	2.7	3.8	4.15	5.2	3.0
11	2.7	2.65	2.6	2.7	4.3	5.3	5.1	2.95
12	2.7	2.65	2.6	2.7	4.5	5.8	5.1	2.95
13	2.7	2.65	2.6	2.7	4.7	5.8	5.6	3.2
14	2.7	2.65	2.6	2.7	4.65	6.2	5.65	3.15
15	2.7	2.65	2.6	2.65	4.7	5.8	5.5	3.05
16	2.7	2.65	2.6	2.66	4.6	5.7	5.1	3.0
17	2.7	2.65	2.6	2.65	4.4	5.5	4.9	3.0
18	2.7	2.65	2.6	2.65	4.25	5.4	4.86	3.0
19	2.7	2.65	2.6	2.65	4.0	5.3	4.6	2.95
20	2.7	2.65	2.6	2.65	4.0	5.2	4.5	2.95
21	2.7	2.65	2.6	2.65	4.1	5.2	4.4	2.95
22	2.7	2.65	2.6	2.65	4.0	5.2	4.35	3.2
23	2.7	2.65	2.6	2.65	3.95	5.1	4.2	3.4
24	2.7	2.65	2.6	2.65	3.95	4.85	4.05	3.4
25	2.7	2.65	2.6	2.65	4.0	4.7	3.9	3.4
26	2.7	2.65	2.6	2.65	4.1	4.9	3.75	3.25
27	2.7	2.65	2.65	2.65	4.4	5.1	3.65	3.3
28	2.7	2.65	2.65	2.65	4.4	5.25	3.6	3.2
29	2.7	....	2.65	2.65	4.4	5.0	3.56	3.1
30	2.7	....	2.65	2.65	4.25	4.7	3.5	3.0
31	2.65	....	2.65	....	4.1	....	3.5	3.0

Rating table for Big Lost River near Mackay, Idaho, for 1906.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.50	129	3.30	302	4.10	566	4.90	886	5.70	1,227
2.60	145	3.40	331	4.20	602	5.00	928	5.80	1,271
2.70	163	3.50	362	4.30	640	5.10	970	5.90	1,315
2.80	183	3.60	395	4.40	680	5.20	1,012	6.00	1,360
2.90	205	3.70	429	4.50	720	5.30	1,054	6.20	1,450
3.00	227	3.80	463	4.60	760	5.40	1,097		
3.10	250	3.90	497	4.70	802	5.50	1,140		
3.20	275	4.00	531	4.80	844	5.60	1,183		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904-1906 and is well defined.

Monthly discharge of Big Lost River near Mackay, Idaho, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	163	154	163	10,000
February	154	154	154	8,550
March	154	145	148	9,100
April	163	154	156	9,280
May	802	154	507	31,200
June	1,450	531	914	54,400
July	1,200	362	814	50,000
August	362	216	270	16,600
The period	....	....	....	180,000

NOTE.—Values are rated as excellent. Flow assumed unaffected by ice conditions.

BIG LOST RIVER NEAR CHILLY, IDAHO.

This station was established April 25, 1904, and was discontinued August 31, 1906. It was located at Howell's ranch, the last one on the left bank, about 25 miles upstream from Mackay, 7 miles from Chilly, and about 3 miles above Kinickinick Point.

The gage is a vertical staff on the left bank one-half mile above the cable, 300 feet from Mr. Howell's house. Until April 20, 1906, the gage was located one-quarter mile from the house. It was moved in order to place it on the main channel. During 1906 it was read once each day by Miss Maud Howell. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 110, where are given also references to publications that contain data for previous years.

Discharge measurements of Big Lost River near Chilly, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 21	E. C. La Rue	81	149	2.50	233
April 22	do	81	163	2.67	300
May 8	do	84	216	3.35	740
May 9	do	85	239	3.60	909
May 24	do	83	213	3.28	651
June 14	do	92	308	4.30	1,790
August 7	do	81.5	166	2.68	310
August 8	do	81.5	163	2.70	318

Daily gage height, in feet, of Big Lost River near Chilly, Idaho, for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Day.	Apr.	May.	June.	July.	Aug.
1		2.75	3.2	3.6	2.8	17		3.35	4.1	3.6	2.5
2		2.9	3.1	3.8	2.8	18		3.3	3.85	3.5	2.5
3		3.1	3.2	3.9	2.75	19		3.2	3.75	3.3	2.6
4		3.35	3.4	4.0	2.7	20	(a)	3.4	3.7	3.25	2.6
5		3.3	3.5	3.95	2.7	21	2.5	3.4	3.85	3.25	2.7
6		3.3	3.5	3.9	2.7	22	2.65	3.3	3.9	3.25	2.7
7		3.3	3.3	4.0	2.7	23	2.9	3.3	3.65	3.2	2.75
8		3.4	3.25	3.85	2.7	24	2.8	3.3	3.5	3.35	2.7
9		3.6	3.3	3.8	2.65	25	2.7	3.4	3.6	3.05	2.6
10		3.8	3.5	3.7	2.6	26	2.65	3.6	3.8	3.2	2.55
11		3.8	3.9	3.75	2.6	27	2.65	3.5	3.8	2.95	2.5
12		3.9	4.55	3.8	2.6	28	2.6	3.4	3.9	2.9	2.5
13		3.8	4.7	4.0	2.7	29	2.7	3.3	3.6	2.85	2.5
14		3.85	4.3	3.9	2.6	30	2.75	3.2	3.45	2.85	2.5
15		3.75	4.15	3.7	2.6	31		3.2		2.9	2.5
16		3.5	4.4	3.5	2.5						

[a] Frozen over January 1 to April 20.

Rating table for Big Lost River near Chilly, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	90	2.70	320	3.30	660	3.90	1,260	4.50	2,080
2.20	120	2.80	370	3.40	740	4.00	1,380	4.60	2,230
2.30	155	2.90	420	3.50	820	4.10	1,510	4.70	2,380
2.40	195	3.00	475	3.60	910	4.20	1,650		
2.50	235	3.10	530	3.70	1,020	4.30	1,790		
2.60	275	3.20	590	3.80	1,140	4.40	1,930		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1906 and is well defined.

Monthly discharge of Big Lost River near Chilly, Idaho, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
April 21-30	420	235	318	6,310
May	1,260	345	770	47,300
June	2,380	530	1,100	65,800
July	1,380	395	885	54,400
August	370	235	288	17,700
The period				192,000

NOTE.—Values are rated as excellent.

BIG WOOD RIVER NEAR SHOSHONE, IDAHO.

This station was established June 5, 1905, and was discontinued December 31, 1906. It was located at A. D. Silva's ranch, 1 mile below the steel wagon bridge and 7 miles northwest of Shoshone, Idaho. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 113, where are given also references to publications that contain data for previous years.

Discharge measurements of Big Wood River near Shoshone, Idaho, in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 17	E. C. La Rue	86	112	2.50	68
1906.					
April 9	do	91	297	4.76	767
April 13	do	94	469	6.50	1,810
April 25	do	92	427	6.02	1,510
May 5	do	92	350	5.25	1,060
May 18	do	89	287	4.63	699
June 8	do	89	262	4.31	552
July 6	do	88	249	4.18	502
July 13	do	88	223	3.87	404
July 26	do	86	122	2.70	91

Daily gage height, in feet, of Big Wood River near Shoshone, Idaho, for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1		3.3	5.05	4.3	3.9	1.95	17		7.45	4.95	5.05	3.6	
2		2.5	5.1	4.15	3.8	1.75	18		7.1	4.7	4.85	3.4	
3		2.3	5.0	4.0	4.0		19		6.9	4.5	4.65	3.4	
4		2.2	5.1	4.0	4.1		20		6.0	4.3	4.55	3.2	
5		2.2	5.25	4.1	4.2		21		5.8	4.25	4.4	3.1	
6		2.3	5.25	4.4	4.2		22		5.8	4.15	4.3	2.9	
7		3.2	5.15	4.45	4.15		23		6.0	4.0	4.4	2.8	
8		4.0	5.0	4.35	4.2		24		6.2	3.9	4.2	3.0	
9		4.6	5.0	4.2	4.2		25		6.1	3.8	4.05	2.8	
10		5.4	5.0	4.0	4.25		26	2.2	5.9	3.75	3.75	2.75	
11		5.7	5.05	4.0	4.05		27	2.35	5.7	4.05	4.1	2.6	
12		6.4	5.05	4.1	4.0		28	2.35	5.4	4.3	4.2	2.4	
13		6.4	5.1	4.9	3.9		29	3.1	5.15	4.5	4.4	2.35	
14		6.9	5.1	5.35	3.9		30	3.4	5.1	4.5	4.15	2.2	
15		8.0	5.2	5.1	4.0		31	3.3		4.4		2.0	
16		7.9	5.2	4.95	3.8								

NOTE.—The river was dry January 1 to March 25 and August 2 to December 31.

Rating table for Big Wood River near Shoshone, Idaho, for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	0	2.90	124	3.90	410	4.90	845	6.60	1,870
2.00	9	3.00	145	4.00	445	5.00	900	6.80	2,010
2.10	19	3.10	170	4.10	480	5.20	1,010	7.00	2,150
2.20	29	3.20	195	4.20	515	5.40	1,130	7.20	2,300
2.30	40	3.30	220	4.30	550	5.60	1,230	7.40	2,450
2.40	51	3.40	250	4.40	590	5.80	1,370	7.60	2,610
2.50	63	3.50	280	4.50	635	6.00	1,490	7.80	2,780
2.60	76	3.60	310	4.60	685	6.20	1,610	8.00	2,950
2.70	90	3.70	340	4.70	735	6.40	1,740		
2.80	106	3.80	375	4.80	790				

NOTE.—The above table is applicable for open-channel conditions. It is based on 10 discharge measurements made during 1905–6 and is well defined.

Monthly discharge of Big Wood River near Shoshone, Idaho, for 1905–6.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
1905.[a]				
June 5–30	410	115	260	13,400
July	115	0	58	3,570
The period				17,000
1906.[b]				
January			0	0
February			0	0
March	250	0	24	1,480
April	2,950	29	1,240	73,500
May	1,040	357	760	46,700
June	1,100	357	604	35,900
July	532	9	300	18,400
August	4	0	.13	8
September			0	0
October			0	0
November			0	0
December			0	0
The year				176,000

[a] Values for 1905 are rated as good.

[b] Values for 1906 are rated as follows: March and August, approximate; April to June, excellent; July, good.

NOTE.—River dry July 28 to December 31, 1905.

SUCCOR CREEK NEAR HOMEDALE, IDAHO.

This station was established March 19, 1903. It was originally located at a small truss bridge built to carry a flume, about one-half mile above the mouth of the river. The station was moved January 31, 1905, about one-half mile upstream to a location 1 mile west of Homedale and about 17 miles from Caldwell, the nearest railroad station. It is near the Caldwell-Jordan Valley stage road, 1 mile west of Mussel's ferry on Snake River, one-fourth mile below the head of the lowest ditch on Succor Creek, and about three-fourths mile above the mouth of the creek. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 114, where are given also references to publications that contain data for previous years.

Discharge measurements of Succor Creek near Homedale, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft*
March 9	E. C. La Rue	35	46	3.58	126
March 10	do	40	58	3.90	216
April 3	do	45	71	4.35	370
June 7	do	36	47	3.50	125
July 3	do	....	.30	2.10	.2

Daily gage height, in feet, of Succor Creek near Homedale, Idaho, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Dec.
1	1.95	2.6	3.25	4.6	3.3	3.95	....
2	1.95	2.55	3.05	4.6	3.3	3.9	....
3	1.95	2.55	3.05	4.2	3.25	3.6	....
4	1.95	2.6	3.6	3.9	3.2	3.6	....
5	1.95	2.65	3.25	4.0	3.2	3.75	2.0
6	1.95	2.65	3.25	4.3	3.1	3.6	2.1
7	1.95	2.6	3.25	4.2	2.95	3.5	2.25
8	1.95	2.6	3.3	4.4	2.9	3.5	2.3
9	1.95	2.55	3.5	4.5	2.9	3.45	2.3
10	1.95	2.5	3.8	4.3	2.85	3.4	2.3
11	2.0	2.6	3.4	3.8	2.8	3.2	2.3
12	2.0	2.55	3.1	3.5	3.2	3.1	2.3
13	2.3	2.55	3.1	3.4	3.05	3.0	2.3
14	2.2	2.6	3.1	3.5	2.95	2.95	2.3
15	2.3	2.8	3.1	3.6	3.0	2.9	2.3
16	2.3	3.45	2.75	3.8	2.9	3.0	2.3
17	2.3	3.5	2.7	3.8	2.8	2.9	2.3
18	2.4	3.4	2.8	3.7	2.75	2.8	2.3
19	3.75	4.2	2.8	3.7	2.7	2.7	2.3
20	2.5	3.25	2.95	3.6	2.65	2.6	2.35
21	2.5	3.4	3.0	3.8	2.65	2.45	2.3
22	2.5	3.25	3.95	3.8	2.65	2.45	2.3
23	2.65	3.0	4.0	3.7	2.55	2.45	2.3
24	3.25	3.0	4.6	3.7	2.5	2.2	2.35
25	3.3	3.05	4.75	3.7	2.45	2.15	2.4
26	3.3	2.95	4.2	3.5	2.4	2.1	2.35
27	2.9	3.3	4.3	3.45	2.3	2.45	2.3
28	2.8	4.15	4.0	3.35	2.7	2.25	2.45
29	2.7	....	3.9	3.3	4.75	2.1	2.5
30	2.6	....	4.2	3.3	4.2	2.0	2.45
31	2.65	....	4.7	....	4.0	....	2.5

NOTE.—Creek dry June 30 to December 4, 1906.

Rating table for Succor Creek near Homedale, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	0.0	2.60	18	3.20	71	3.80	184	4.40	389
2.10	.2	2.70	24	3.30	83	3.90	214	4.50	426
2.20	3	2.80	31	3.40	97	4.00	247	4.60	464
2.30	6	2.90	40	3.50	114	4.10	281	4.70	502
2.40	9	3.00	50	3.60	134	4.20	316	4.80	542
2.50	13	3.10	60	3.70	157	4.30	352		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906, and is not well defined below 3.5 feet.

Monthly discharge of Succor Creek near Homedale, Idaho, for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	170	0	20.7	1,270
February	316	13	61.9	3,440
March	522	24	158	9,720
April	464	83	210	12,500
May	522	6	71.2	4,380
June	230	0	64.3	3,830
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
October	0	0	0	0
November	0	0	0	0
December	13	0	5.8	357
The year				35,500

NOTE.—Values are rated as follows: January, February, May, June, and December, approximate; March and April, good. Flow assumed unaffected by ice during winter period.

OWYHEE RIVER NEAR OWYHEE, OREG.

This station was established August 27, 1903, at the county bridge 1½ miles from Owyhee, Oreg. Owyhee ditch takes water from the river about 6 miles above. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 116, where are given also references to publications that contain data for previous years.

Discharge measurements of Owyhee River near Owyhee, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 8	R. S. Hall	273	556	3.58	760
March 31	do	290	1,870	8.32	9,620
April 13	do	286	1,720	7.61	7,780
April 27	do	286	1,470	6.72	5,440
June 13	do	282	940	5.02	2,290
November 29[a]	Stevens and McGlashan	120	192	2.80	231

[a] Slush ice running. Right channel entirely frozen.

Daily gage height, in feet, of Owyhee River near Owyhee, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.97	3.42	3.42	9.00	5.90	7.12	3.97	2.02	2.02	2.37	2.32	2.75
2	2.97	3.37	3.42	8.97	5.87	7.10	3.87	2.04	2.02	2.37	2.32	2.75
3	2.97	3.32	3.42	7.78	5.82	6.52	3.72	2.00	2.02	2.37	2.32	2.75
4	2.97	3.37	3.42	7.24	5.79	6.42	3.62	1.97	2.02	2.37	2.32	2.75
5	2.97	3.37	3.42	7.04	5.77	6.27	3.67	1.92	2.02	2.37	2.32	2.75
6	3.02	3.37	3.42	7.02	5.72	6.02	3.47	1.92	2.02	2.37	2.32	2.75
7	3.02	3.37	3.42	7.14	5.67	5.87	3.32	1.92	2.02	2.42	2.34	2.75
8	3.02	3.37	3.57	8.12	5.57	5.74	3.22	1.92	2.02	2.37	2.37	2.75
9	3.02	3.37	3.90	8.87	5.47	5.52	3.22	1.92	2.02	2.37	2.40	2.75
10	3.02	3.37	4.02	9.00	5.37	5.67	3.42	1.92	2.02	2.37	2.42	2.75
11	3.02	3.27	4.10	8.60	5.27	5.57	2.97	1.92	2.02	2.30	2.45	2.75
12	3.22	3.32	4.12	8.22	5.37	5.47	2.97	1.92	2.02	2.30	2.47	2.75
13	3.22	3.27	4.12	7.72	5.27	5.37	2.92	1.92	2.04	2.30	2.52	2.75
14	3.22	3.22	4.12	7.32	5.22	5.27	2.92	1.92	2.04	2.30	2.57	2.75
15	3.22	3.22	4.12	7.32	5.17	5.07	2.90	1.92	2.02	2.30	2.60	2.75

Daily gage height, in feet, of Owyhee River near Owyhee, Oreg., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.22	3.22	4.17	7.42	5.12	4.92	2.87	1.92	2.02	2.30	2.64	2.75
17	3.22	3.17	4.07	7.57	5.07	4.77	2.87	1.92	2.07	2.30	2.70	2.75
18	3.22	2.92	3.87	7.42	5.02	4.57	2.82	1.97	2.14	2.30	2.72	2.75
19	3.60	3.00	3.70	7.32	4.97	4.47	2.82	1.97	2.14	2.30	2.72	2.75
20	3.90	3.07	3.57	7.27	4.92	4.47	2.82	1.97	2.14	2.32	2.72	2.75
21	3.42	3.06	3.47	6.87	4.82	4.39	2.80	1.97	2.14	2.32	2.72	2.75
22	3.42	3.17	3.47	6.82	4.67	4.32	2.72	1.97	2.14	2.32	2.72	2.75
23	3.42	3.32	5.70	6.72	4.57	4.17	2.62	1.97	2.14	2.32	2.72	2.75
24	3.42	3.37	5.44	6.52	4.42	4.11	2.57	1.97	2.14	2.32	2.72	2.76
25	3.47	3.52	6.61	6.62	4.27	4.02	2.47	2.02	2.14	2.32	2.72	2.75
26	3.47	3.42	7.62	6.52	4.22	3.97	2.32	2.02	2.14	2.32	2.72	2.75
27	3.47	3.37	8.04	6.47	4.14	3.92	2.27	2.02	2.37	2.32	2.67	2.75
28	3.47	3.37	7.94	6.42	4.12	3.87	2.22	2.02	2.37	2.32	2.67	2.80
29	3.47	....	8.02	6.32	4.62	3.90	2.17	2.02	2.37	2.32	2.75	2.85
30	3.47	....	7.87	6.12	6.62	3.97	2.12	2.02	2.37	2.32	2.75	2.85
31	3.47	....	8.52	....	7.07	....	2.07	2.02	....	2.32	....	2.90

Note.—There was probably some obstruction from ice during the latter part of November and December. No correction has been made in discharge.

Rating table for Owyhee River near Owyhee, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.90	15	2.90	295	3.90	995	4.90	2,100	6.80	5,680
2.00	25	3.00	350	4.00	1,080	5.00	2,240	7.00	6,160
2.10	35	3.10	410	4.10	1,170	5.20	2,540	7.20	6,660
2.20	50	3.20	475	4.20	1,270	5.40	2,860	7.40	7,180
2.30	70	3.30	540	4.30	1,370	5.60	3,210	7.60	7,700
2.40	95	3.40	610	4.40	1,480	5.80	3,580	7.80	8,240
2.50	125	3.50	680	4.50	1,590	6.00	3,960	8.00	8,780
2.60	160	3.60	755	4.60	1,710	6.20	4,360	9.00	11,570
2.70	200	3.70	830	4.70	1,830	6.40	4,780		
2.80	245	3.80	910	4.80	1,960	6.60	5,220		

Note.—This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined.

Monthly discharge of Owyhee River near Owyhee, Oreg., for 1906.

[Drainage area, 9,880 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	995	333	519	31,900	0.052	0.06
February	695	306	533	29,600	.054	.06
March	10,200	624	2,700	166,000	.272	.31
April	11,600	4,200	7,250	432,000	.733	.82
May	6,340	1,190	2,700	166,000	.270	.31
June	6,460	970	2,640	157,000	.267	.30
July	1,060	32	367	22,600	.037	.04
August	29	17	21.5	1,320	.0022	.002
September	88	27	39.6	2,360	.0040	.004
October	102	70	78.2	4,810	.0079	.01
November	222	75	152	9,040	.015	.02
December	295	222	228	14,000	.023	.03
The year	11,600	17	1,210	1,040,000	.122	1.97

Note.—Values are rated as good.

BOISE RIVER NEAR HIGHLAND, IDAHO.

This station was established on July 27, 1905, to replace the Boise station. It is located 2 miles below the mouth of Moores Creek, 3 miles southwest of Highland post-office, about 8 miles above the old Boise station, and 15 miles east of Boise, the nearest railroad point. The conditions and the bench marks are described in Water-Supply Paper No. 178, page 121.

Discharge measurements of Boise River near Highland, Idaho, in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 3	E. C. La Rue	180	309	3.85	1,130
April 4	do	220	831	6.38	3,150
April 15	do	253	1,260	8.20	5,630
May 16	do	235	1,520	9.40	7,260
June 6	do	250	1,340	8.80	6,590
June 29	do	226	1,160	7.90	5,040
July 11	do	220	844	6.55	3,090
July 16	do	216	669	5.75	2,350
July 20	do	202	550	5.10	1,750
July 24	do	193	442	4.60	1,480
July 27	do	188	368	4.20	1,310

Daily gage height, in feet, of Boise River near Highland, Idaho, for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	3.3	3.5	4.0	7.55	9.1	8.35	7.25	3.9	3.4	3.15	3.4
2	3.3	3.45	3.85	6.9	9.2	8.2	7.35	3.85	3.4	3.1	3.4
3	3.25	3.45	3.85	6.55	9.5	8.3	7.5	3.8	3.45	3.15	3.4
4	3.3	3.5	3.85	6.4	9.9	8.6	7.55	3.8	3.35	3.25	3.4
5	3.4	3.4	3.85	6.25	9.5	8.65	7.4	3.7	3.3	3.35	3.45
6	3.6	3.45	3.3	6.8	9.35	8.85	7.3	3.65	3.3	3.35	3.45
7	3.4	3.45	3.8	7.4	9.25	8.35	7.2	3.65	3.25	3.3	3.5
8	3.4	3.5	4.0	7.95	9.45	8.35	7.05	3.6	3.25	3.2	3.5
9	3.4	3.5	4.4	8.05	9.55	8.2	6.9	3.55	3.25	3.2	3.55
10	3.5	3.5	4.6	8.3	9.95	8.25	6.7	3.5	3.25	3.15	3.6
11	3.6	3.5	4.5	7.75	10.05	8.5	6.55	3.45	3.25	3.15	3.6
12	3.6	3.6	4.4	7.6	10.3	9.5	6.5	3.4	3.25	3.2	3.5
13	3.5	3.65	4.3	7.7	10.3	9.85	6.3	3.5	3.45	3.3	3.8
14	3.5	3.7	4.1	7.75	10.15	9.15	6.15	3.55	3.5	3.25	5.75
15	3.5	3.75	3.9	8.2	10.1	9.05	5.9	3.5	3.4	3.15	6.0
16	3.5	3.9	3.6	8.6	9.5	8.95	5.75	3.4	3.35	3.25	8.05
17	3.5	4.0	3.4	8.75	8.85	8.95	5.6	3.4	3.3	3.3	5.5
18	3.8	4.1	3.5	8.8	8.5	8.55	5.45	3.35	3.3	3.35	4.6
19	3.7	4.25	3.6	8.85	8.35	8.3	5.3	3.25	3.25	3.3	3.95
20	3.6	4.2	3.8	8.9	8.35	8.15	5.1	3.3	3.25	3.3	3.9
21	3.5	4.1	3.9	9.5	8.35	8.1	4.95	3.3	3.2	3.3	4.0
22	3.7	4.2	4.0	9.9	8.25	8.0	4.85	3.4	3.15	3.3	4.0
23	3.6	4.1	4.3	10.2	8.1	7.9	4.95	3.55	3.15	3.3	3.8
24	3.5	3.95	4.65	9.75	8.15	7.7	4.6	3.65	3.15	3.3	3.7
25	3.5	3.9	5.65	9.5	8.2	7.7	4.45	3.6	3.15	3.3	3.7
26	3.7	3.9	6.2	8.9	9.25	7.8	4.35	3.45	3.15	3.3	3.65
27	3.6	3.85	6.5	8.75	9.05	7.9	4.2	3.45	3.15	3.3	3.65
28	3.5	4.15	6.5	8.7	8.9	3.5	4.15	3.35	3.15	3.35	3.65
29	3.5		6.65	8.9	8.85	7.9	4.05	3.45	3.15	3.35	3.55
30	3.4		6.75	8.95	8.6	7.5	4.0	3.45	3.15	3.35	3.5
31	3.4		7.25		8.5		3.95	3.4		3.35	

NOTE.—Record discontinued for the winter on December 1.

Rating table for Boise River near Highland, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	560	4.00	1,240	5.00	1,700	6.00	2,620	8.00	5,180
3.10	600	4.10	1,280	5.10	1,780	6.20	2,840	8.20	5,470
3.20	650	4.20	1,310	5.20	1,860	6.40	3,060	8.40	5,770
3.30	700	4.30	1,350	5.30	1,940	6.60	3,300	8.60	6,070
3.40	750	4.40	1,390	5.40	2,020	6.80	3,540	8.80	6,370
3.50	810	4.50	1,430	5.50	2,110	7.00	3,800	9.00	6,670
3.60	880	4.60	1,470	5.60	2,200	7.20	4,060	10.00	8,240
3.70	960	4.70	1,510	5.70	2,300	7.40	4,340		
3.80	1,060	4.80	1,560	5.80	2,400	7.60	4,620		
3.90	1,160	4.90	1,620	5.90	2,510	7.80	4,900		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 15 discharge measurements made during 1905–6, and is well defined between gage heights 3 feet and 9 feet.

Monthly discharge of Boise River near Highland, Idaho, for 1906.

[Drainage area, 2,610 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec-ft. per sq. mile.	Depth in inches.
January	1,060	675	820	50,400	0.314	0.36
February	1,330	750	1,020	56,800	.391	.41
March	4,130	750	1,630	100,000	.624	.72
April	8,560	2,900	5,630	335,000	2.15	2.40
May	8,720	5,320	6,900	425,000	2.64	3.04
June	8,000	4,480	8,780	344,000	2.21	2.47
July	4,550	1,200	2,630	162,000	1.00	1.15
August	1,160	675	839	51,600	.321	.37
September	810	625	685	40,800	.262	.29
October	725	600	683	42,000	.261	.30
November	5,250	750	1,220	72,800	.468	.52
The period				1,680,000		

NOTE.—Values are rated as excellent. Flow assumed unaffected by ice conditions during the winter months

SEEPAGE INVESTIGATIONS ON BOISE RIVER.

The following is a detailed report of the investigation made by E. C. La Rue during October, 1906, in order to determine the amount of seepage water returning to Boise River between the mouth of its canyon, 8 miles above Boise, and Caldwell Canyon, 2½ miles above Caldwell, Idaho.

The distance by river between the points is 34 miles. This distance was covered on foot and by following the river bank, and the discharge of every diversion and tributary was carefully noted.

The gage reading at the Highland station on Boise River, about 8 miles above the mouth of Boise Canyon, was 3.20 on October 9, 1906, which corresponds to a discharge of 650 second-feet. From here to Boise Canyon the river flows through a narrow rocky canyon and receives no tributaries. Consequently 650 second-feet is the discharge at the mouth of the canyon, just above the New York canal heading. On October 12, 1906, the day the investigation was finished, the gage at the Highland station still read 3.20. Therefore during this period of investigation the uniform available supply of the river above all irrigation was 650 second-feet.

The net seepage will be the difference between the discharge of the river at the upper point, plus all tributaries between the two points of measurement, and the discharge of the river at the lower point, plus all diverted water between the two points in question.

The results are expressed in the following table:

Discharge of Boise River at upper point, plus tributaries.

Date.	Stream.	Locality of heading or place of measurement.	Discharge in second-feet.
1906.			
October 9	Boise River	At mouth of canyon, above New York canal heading.	650
October 9	Waste from sloughs	Between Ninth and Broadway Bridge	.5
October 9	Waste from canals and sloughs.	Between Broadway Bridge and Ridenbaugh canal heading.	2.8
October 10	Waste from Rossi canal	½ mile below Broadway Bridge	17.8
October 10	do	Just above Oregon Short Line Railway bridge.	38.1
October 10	do	Just below Oregon Short Line Railway bridge.	98.6
October 10	Waste	Below Mill slough ditch heading	13.0
October 10	do	From Lower Mill slough ditch	3.0
October 10	do	Just above Phyllis canal heading	1.0
October 10	do	From Eureka canal	3.0
October 11	do	3 miles below Star Bridge	4.0
October 11	Willow Creek waste	½ mile below Middleton	21.1
October 12	Waste Middleton Mill slough.	At Middleton	4.0
October 12	Waste	Just below Farmers' Union canal heading	2.0
October 12	do	Boise City sewer discharge	10.0
	Total		863.9

Discharge of Boise River at lower point, plus all diversions.

Date.	Stream.	Locality of heading or place of measurement.	Discharge in second-feet.
1906.			
October 9	New York canal	Below all waste	95.5
October 9	Ridenbaugh canal	Just below wasteway	209.4
October 9	Rossi canal	Just above wasteway	205.9
October 9	Small diversion	¼ mile above Rossi heading	1.0
October 9	Payne ditch	At heading	1.0
October 10	Davis or Mill slough ditch	Below wasteway	20.1
October 10	Joplin ditch	At heading	4.0
October 10	Eureka canal	Below wasteway	9.3
October 10	Phyllis canal	do	58.6
October 11	Boise River	At lower point of measurement, 2¼ miles above Caldwell.	95.1
October 11	Caldwell Highline canal	Below all waste	26.7
October 12	Canyon County canal	Below wasteway	9.2
October 12	Small diversion	3 miles above Star	1.0
October 12	Middleton Mill ditch	Below wasteway	35.0
October 12	Middleton Mill slough ditch	do	8.9
October 12	Pioneer or Stewart ditch		0.0
October 12	Ballantyne ditch	Below all waste	1.0
October 12	Dry Creek ditch	Below wasteway	10.8
October 12	Farmers' Union and Valley ditch.	do	61.6
October 12	Boise City ditch	do	0.5
October 12	Perrault ditch	At penitentiary	9.4
	Total		873.0

Investigations similar to the foregoing were made during 1898, 1901, 1902, 1903, and 1905. The results of these investigations, including the summary for 1906, are given below:

Seepage gains in Boise River.

	Sec.-ft.	Sec.-ft.
1898, August 24 to September 2:		
Amount taken out by canals		1, 160. 0
Amount in river above canals	734	
Amount of measured return water	197	
Total	931	
Amount in river at Caldwell station	31	
Difference		900. 0
Gain by seepage in 34 miles		260. 0
1901, August 13 to 17:		
Discharge Boise River above New York canal heading		821. 0
Discharge Boise River at Caldwell Canyon	73. 3	
Amount of measured return water		131. 0
Amount taken out by canals	1, 140. 1	
Gain by seepage in 34 miles		261. 4
	1, 213. 4	1, 213. 4
1902, August 11 to 15:		
Discharge Boise River at upper point		924. 5
Discharge Boise River at lower point	1. 5	
Amount of measured return waters		174. 4
Amount taken out by canals	1, 309. 0	
Gain by seepage in 34 miles		211. 6
	1, 310. 5	1, 310. 5
1903, October 24 to 29:		
Discharge of Boise River at upper point		771. 6
Discharge of Boise River at lower point	619. 4	
Amount of measured return waters		362. 6
Amount taken out by canals	654. 4	
Gain by seepage in 34 miles		[a] 139. 6
	1, 273. 8	1, 273. 8
1905, October 2 to 7:		
Discharge Boise River at upper point		602. 0
Discharge Boise River at lower point	106. 6	
Amount of measured return waters		82. 7
Amount taken out by canals	601. 5	
Gain by seepage in 34 miles		23. 4
	708. 1	708. 1

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[a] Mistakes were found in calculation. The result of 255.3 second-feet gain, as published in Water-Supply Paper No. 100, should read 139.6 second-feet.

1906, October 9 to 12:	Sec.-ft.	Sec.-ft.
Discharge Boise River at upper point		650.0
Discharge Boise River at lower point	95.1	
Amount of measured return water		218.9
Amount taken out by canals	777.9	
Gain by seepage in 34 miles		4.1
	873.0	873.0

PAYETTE RIVER NEAR HORSESHOE BEND, IDAHO.

This station was established February 13, 1906. It is located at a point known as Jerusalem, 5 miles above Horseshoe Bend postoffice, Idaho, and about 32 miles from Boise, the most convenient railway point.

The channel is straight for 1,000 feet above and below the station. The water is comparatively swift during all stages. Both banks are firm, rather steep, and not liable to overflow. The bed of the stream is strewn with small smooth bowlders, and is permanent.

Discharge measurements are made by means of a cable and car. The initial point for soundings is the inner face of the pine tree which acts as the right cable support.

The gage, which was read once each day by E. R. Sherard, is inclined and is located on the right bank directly under the cable. The bench mark is a United States Geological Survey aluminum tablet set in the base of the pine tree which is used as the cable support on the right bank; elevation, 12.53 feet above the datum of the gage.

Discharge measurements of Payette River near Horseshoe Bend, Idaho, by E. C. La Rue, in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 24	253	475	4.21	1,250
April 5	265	811	5.46	3,100
April 15	273	1,060	6.40	5.030
May 3	275	1,200	6.97	5,600
May 15	281	1,530	8.15	9,620
June 27	270	1,110	6.60	5.510
July 10	269	878	5.75	3,630
July 19	260	656	4.95	2,150
August 2	252	498	4.30	1,330

Daily gage height, in feet, of Payette River near Horseshoe Bend, Idaho, in 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		4.1	5.65	6.8	7.1	5.5	4.35	3.9	3.8	3.95
2		4.0	5.55	6.8	6.75	5.35	4.3	3.85	3.8	3.95
3		4.0	5.4	7.0	6.6	6.3	4.3	3.85	3.8	3.95
4		4.05	5.45	7.15	6.8	5.25	4.25	3.85	3.75	3.95
5		4.0	5.35	7.15	7.15	6.2	4.25	3.8	3.75	3.95
6		4.0	5.5	7.1	7.1	6.15	4.2	3.8	3.75	3.95
7		4.0	5.8	7.1	6.9	5.05	4.2	3.8	3.75	4.0
8		4.1	5.0	7.06	5.9	6.0	4.15	3.8	3.75	4.1
9		4.2	6.1	7.15	6.8	5.95	4.15	3.75	3.75	4.2
10		4.3	6.5	7.4	6.7	5.85	4.1	3.75	3.75	4.25

Daily gage height, in feet, of Payette River, near Horseshoe Bend, Idaho, in 1906—Cont'd.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	....	4.35	6.2	7.65	6.65	5.7	4.1	3.75	3.75	4.5
12	....	4.2	6.1	8.0	7.2	5.5	4.15	3.8	3.75	5.0
13	3.9	4.2	6.05	8.1	7.25	5.45	4.15	3.8	3.75	6.0
14	3.9	4.15	6.0	8.1	7.4	5.35	4.2	3.9	3.8	6.4
15	4.0	4.1	6.1	8.1	7.5	5.3	4.15	4.0	3.8	6.4
16	4.05	4.0	6.4	8.0	7.5	5.25	4.1	4.0	3.8	6.0
17	4.05	4.0	6.4	7.5	7.6	5.1	4.0	4.0	3.8	5.5
18	4.05	4.0	6.5	7.25	7.4	5.0	4.0	3.95	3.8	6.0
19	4.1	4.0	5.5	7.05	7.2	4.95	4.05	3.95	3.85	5.5
20	4.15	4.0	6.55	5.9	7.25	4.85	4.05	3.9	3.85	5.2
21	4.15	4.1	5.8	6.9	7.1	4.8	4.0	3.9	3.85	5.0
22	4.2	4.05	7.1	6.8	6.95	4.75	4.0	3.85	3.85	4.9
23	4.2	4.1	7.35	5.85	6.95	4.7	4.0	3.85	3.85	4.8
24	4.1	4.15	7.35	6.85	6.8	4.7	4.0	3.85	3.85	4.7
25	4.05	4.55	7.35	6.85	5.65	4.65	4.0	3.8	3.85	4.7
26	4.0	4.75	7.05	6.95	6.5	4.55	4.0	3.8	3.85	4.65
27	4.0	4.9	6.8	7.05	6.5	4.5	4.0	3.8	3.85	4.65
28	4.1	5.0	5.65	7.5	7.0	4.45	3.95	3.8	3.9	4.6
29	....	5.05	6.65	7.5	6.9	4.45	3.95	3.8	3.9	4.6
30	....	5.15	6.75	7.2	6.85	4.4	3.9	3.8	3.9	4.6
31	....	5.25	....	7.25	....	4.35	3.9	....	3.9	(a)

[a] Record discontinued for the winter.

Rating table for Payette River near Horseshoe Bend, Idaho, for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.70	760	4.70	1,800	5.70	3,530	6.70	5,760	7.70	8,430
3.80	850	4.80	1,940	5.80	3,720	6.80	6,020	7.80	8,710
3.90	940	4.90	2,090	5.90	3,920	6.90	5,280	7.90	8,990
4.00	1,030	5.00	2,250	6.00	4,120	7.00	6,540	8.00	9,270
4.10	1,130	5.10	2,420	6.10	4,330	7.10	6,800	8.10	9,550
4.20	1,230	5.20	2,590	6.20	4,550	7.20	7,070	8.20	9,830
4.30	1,330	5.30	2,770	6.30	4,780	7.30	7,340		
4.40	1,440	5.40	2,960	5.40	5,020	7.40	7,610		
4.50	1,550	5.50	3,150	5.50	5,260	7.50	7,880		
4.60	1,670	5.60	3,340	6.60	5,510	7.60	8,150		

NOTE.—The above table is applicable only to open-channel conditions. It is based on 9 discharge measurements made during 1906 and is well defined.

Monthly discharge of Payette River near Horseshoe Bend, Idaho, for 1906.

[Drainage area, 2,240 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
February 13–28	1,230	940	1,090	34,700	0.488	0.29
March	2,680	1,030	1,930	118,000	.859	.99
April	7,480	2,860	4,960	295,000	2.21	2.47
May	9,550	6,020	7,260	446,000	3.24	3.74
June	8,150	5,260	6,560	390,000	2.92	3.26
July	5,260	1,380	2,900	178,000	1.30	1.50
August	1,380	940	1,120	69,200	.502	.58
September	1,030	805	894	53,200	.399	.44
October	940	805	859	52,800	.383	.44
November	5,020	985	2,130	127,000	.952	1.06
The period	....	....	....	1,760,000	....	....

NOTE.—Values are rated as follows: February to August and November, excellent; September and October, good.

MALHEUR RIVER AT M'LAUGHLIN'S BRIDGE, NEAR VALE, OREG.

This station was established December 10, 1904, and was discontinued December 20, 1906. It is located at the new county bridge, known as McLaughlin's bridge, 10 miles above Vale, Oreg. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 129, where are given also references to publications that contain data for previous years.

Discharge measurements of Malheur River at McLaughlin's bridge, near Vale, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 3	R. S. Hall	81	131	3.18	328
April 26	do	153	568	5.11	2,680
November 28[a]	Stevens and McGlashan	45	120	1.71	107

[a] Channel frozen over above and below bridge.

Daily gage height, in feet, of Malheur River at McLaughlin Bridge, near Vale, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.60	3.62	3.55	10.06	4.25	4.00	2.40	1.35	1.25	1.65	1.90	2.35
2	3.60	3.62	3.25	8.28	4.15	3.62	2.30	1.35	1.30	1.65	1.90	2.35
3	3.60	3.62	3.20	7.85	4.10	3.65	2.30	1.30	1.30	1.70	1.95	2.35
4	3.60	3.62	3.15	7.25	4.05	3.60	2.25	1.25	1.40	1.70	1.95	2.35
5	3.60	3.62	3.20	7.80	4.00	3.60	2.25	1.20	1.35	1.70	1.95	2.35
6	3.60	3.62	3.20	7.40	3.95	3.75	2.25	1.20	1.40	1.70	1.95	2.4
7	3.00	3.62	3.30	7.70	3.95	3.70	2.15	1.15	1.40	1.70	1.95	2.4
8	3.60	3.62	3.80	7.92	3.85	3.60	2.15	1.15	1.45	1.70	1.95	2.4
9	3.60	3.62	3.90	8.08	3.75	3.58	2.15	1.15	1.45	1.70	1.95	2.4
10	3.00	3.62	4.20	7.98	3.65	3.55	1.90	1.15	1.45	1.70	1.95	2.3
11	3.60	3.70	4.10	7.40	3.60	3.55	1.90	1.00	1.45	1.70	1.95	2.2
12	3.60	3.70	3.63	6.85	3.60	3.30	1.90	1.00	1.50	1.70	1.95	2.2
13	3.60	3.70	3.50	6.10	3.65	3.30	1.80	1.00	1.50	1.70	2.00	2.2
14	3.60	3.70	3.35	5.90	3.00	3.25	1.75	1.00	1.55	1.65	2.00	2.2
15	3.60	3.70	3.25	5.95	3.55	3.20	1.75	1.00	1.55	1.65	2.00	2.15
16	3.60	3.70	3.25	6.00	3.52	3.20	1.65	1.00	1.55	1.65	2.00	2.15
17	3.60	3.70	3.20	6.15	3.50	3.15	1.65	1.00	1.60	1.70	2.00	2.15
18	3.60	3.70	3.15	6.15	3.45	3.00	1.60	1.00	1.60	1.70	2.00	2.15
19	3.60	3.75	3.15	5.80	3.30	2.90	1.55	1.05	1.60	1.75	2.05	2.15
20	3.60	4.24	3.15	5.38	3.15	2.85	1.52	1.05	1.65	1.75	2.10	......
21	3.60	4.66	3.15	5.44	3.00	2.80	1.52	1.10	1.65	1.75	2.10	......
22	3.60	4.80	3.25	5.44	3.00	2.75	1.42	1.10	1.62	1.80	2.10	......
23	3.60	5.32	3.85	5.38	2.90	2.50	1.50	1.15	1.60	1.80	2.10	......
24	3.60	4.82	5.15	5.30	2.90	2.50	1.42	1.15	1.60	1.80	2.10	......
25	3.60	4.22	7.25	5.22	2.90	2.50	1.50	1.15	1.60	1.80	2.15	......
26	3.60	3.40	7.38	5.09	2.85	2.50	1.42	1.15	1.60	1.80	2.15	......
27	3.60	3.40	7.40	5.04	2.85	2.50	1.42	1.20	1.65	1.80	2.20	......
28	3.60	3.38	7.40	4.72	3.90	2.50	1.42	1.20	1.65	1.80	2.20	......
29	3.60	......	7.30	4.50	4.10	2.50	1.40	1.25	1.65	1.80	2.22	......
30	3.60	......	8.04	4.25	4.70	2.50	1.40	1.25	1.65	1.85	2.30	......
31	3.60	......	9.88	......	4.65	......	1.40	1.25	......	1.90	......	......

NOTE.—The following ice conditions prevailed during 1906: River frozen over January 1 to February 22; gage heights are to the top of ice. On February 22 an ice jam formed at the bridge; this went out February 25. November 13 to 18, slush ice was running in the morning; the gage heights were taken in the afternoon, and were probably not affected. November 19 there was ice along edges and anchor ice in the bottom; this ice went out December 11. December 14 to 19 ice formed at night, but went out in the daytime, and probably did not affect gage heights.

Rating tables for Malheur River at McLaughlin's Bridge, near Vale, Oreg.

JANUARY 1 TO MARCH 31, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.00	270	3.80	755	4.60	1,380	5.40	2,125	6.40	3,610
3.10	320	3.90	825	4.70	1,465	5.50	2,245	6.60	3,970
3.20	375	4.00	900	4.80	1,550	5.60	2,370	6.80	4,350
3.30	430	4.10	975	4.90	1,635	5.70	2,500	7.00	4,750
3.40	490	4.20	1,055	5.00	1,720	5.80	2,640	8.00	7,200
3.50	550	4.30	1,135	5.10	1,810	5.90	2,790	9.00	10,200
3.60	615	4.40	1,215	5.20	1,910	6.00	2,950	10.00	13,250
3.70	685	4.50	1,295	5.30	2,015	6.20	3,270		

APRIL 1 TO DECEMBER 20, 1906.[b]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1.00	5	1.90	215	2.80	630	3.70	1,245	5.20	2,810
1.10	20	2.00	250	2.90	690	3.80	1,325	5.40	3,090
1.20	37	2.10	290	3.00	750	3.90	1,410	5.60	3,380
1.30	56	2.20	330	3.10	815	4.00	1,500	5.80	3,680
1.40	77	2.30	375	3.20	880	4.20	1,690	6.00	4,000
1.50	100	2.40	420	3.30	950	4.40	1,890	7.00	5,900
1.60	125	2.50	470	3.40	1,020	4.60	2,090	8.20	8,150
1.70	155	2.60	520	3.50	1,090	4.80	2,310	9.30	10,650
1.80	185	2.70	575	3.60	1,165	5.00	2,550	10.40	13,250

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6, and is well defined below gage heights 5 feet. The table has been extended by subtracting the discharge of Bully Creek for April 1 from the discharge at Vale.

[b] This table is applicable only for open-channel conditions. It is based on 1 discharge measurement made during 1906 and on the form of the previous curve, and is not well defined.

Monthly discharge of Malheur River at McLaughlin Bridge, near Vale, Oreg., for 1906.

[Drainage area, 4,150 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
March	12,900	348	2,000	123,000	0.482	0.56
April	13,400	1,740	5,100	303,000	1.23	1.37
May	2,200	660	1,220	75,000	.294	.34
June	1,500	470	851	50,600	.205	.23
July	420	77	190	11,700	.046	.05
August	66	5	27.4	1,680	.0066	.01
September	140	46	106	6,310	.026	.03
October	215	140	165	10,100	.040	.05
November 1-18	250	215	236	8,430	.057	.04
December 11-19	330	310	319	5,690	.077	.03
The period				611,000		

Note.—Values are rated as follows: March to June, fair; July to December, approximate.

MALHEUR RIVER AT VALE, OREG.

This station was established May 20, 1903, at the steel highway bridge one-eighth mile southeast of Vale, Oreg., where a station has been maintained at intervals since 1890. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 126, where are given also references to publications that contain data for previous years.

Discharge measurements of Malheur River at Vale, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 29	R. S. Hall	102	175	4.45	212
February 15	do	103	174	4.42	197
February 16	do	104	185	4.49	228
March 2	do	122	230	4.93	432
March 24	do	149	599	6.83	1,990
March 25	do	165	986	9.30	5,300
March 29	do	162	1,010	9.54	5,310
April 9	do	165	1,220	10.82	7,190
April 24	do	146	792	7.58	2,840
April 26	do	144	746	7.40	2,670
May 4	do	127	474	6.12	1,250
June 14	do	117	292	5.14	591

Daily gage height, in feet, of Malheur River at Vale, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.39	4.37	5.23	14.34	6.36	6.36	4.30	3.44	3.40	3.68	3.90	4.01
2	4.16	4.35	4.95	11.55	6.26	5.88	4.26	3.40	3.40	3.68	3.92	4.01
3	4.14	4.31	4.78	9.82	6.20	5.61	4.18	3.40	3.41	3.71	3.93	3.98
4	4.40	4.30	4.75	9.52	6.12	5.50	4.14	3.36	3.42	3.72	3.94	3.96
5	4.48	4.31	4.74	9.50	6.02	5.58	4.12	3.33	3.44	3.73	3.98	3.97
6	4.34	4.66	4.84	9.88	5.95	5.88	4.10	3.32	3.51	3.72	3.99	3.98
7	4.49	4.50	4.87	10.51	5.89	5.76	4.03	3.29	3.48	3.74	4.02	4.02
8	4.24	4.32	5.36	10.62	5.76	5.85	3.96	3.29	3.50	3.74	4.02	4.12
9	4.16	4.43	5.80	10.86	5.64	5.75	3.94	3.28	3.51	3.73	4.04	4.22
10	4.18	4.27	6.10	10.54	5.56	5.57	3.90	3.26	3.49	3.72	4.08	4.21
11	4.19	4.27	6.35	9.86	5.51	5.46	3.82	3.26	3.50	3.73	4.04	4.22
12	4.20	4.28	6.07	8.93	5.61	5.38	3.76	3.30	3.51	3.74	4.04	4.21
13	4.20	4.31	5.56	8.52	5.62	5.24	3.72	3.25	3.50	3.74	4.03	4.23
14	4.22	4.36	5.18	8.30	5.52	5.18	3.66	3.24	3.50	3.70	4.03	4.22
15	4.28	4.41	5.34	8.44	5.40	5.10	3.62	3.25	3.54	3.72	4.05	4.24
16	4.20	4.49	5.27	8.49	5.38	5.04	3.55	3.25	3.58	3.73	4.06	4.20
17	4.38	4.52	4.68	8.62	5.32	4.98	3.50	3.25	3.58	3.74	4.06	4.15
18	4.24	4.52	4.55	8.54	5.26	4.87	3.50	3.24	3.59	3.74	4.05	4.17
19	4.25	4.54	4.55	8.23	5.16	4.87	3.51	3.21	3.64	3.75	4.04	4.22
20	4.38	4.80	4.76	7.90	5.04	4.75	3.49	3.20	3.63	3.77	4.11	4.20
21	4.54	5.28	4.76	7.82	4.98	4.68	3.48	3.20	3.64	3.77	4.12	4.17
22	4.36	5.23	4.80	7.79	4.90	4.60	3.34	3.20	3.66	3.81	4.07	4.24
23	4.36	5.51	5.09	7.75	4.83	4.53	3.37	3.18	3.64	3.88	4.00	4.21
24	4.34	5.21	6.98	7.58	4.78	4.44	3.20	3.20	3.64	3.90	3.92	4.22
25	4.33	5.22	9.36	7.47	4.72	4.38	3.38	3.22	3.64	3.92	3.88	4.22
26	4.65	4.90	9.48	7.38	4.68	4.38	3.34	3.28	3.63	3.94	3.92	4.22
27	4.42	4.82	9.53	7.22	4.64	4.31	3.39	3.30	3.66	3.91	4.00	4.26
28	4.46	4.90	9.82	6.96	4.80	4.27	3.50	3.31	3.65	3.90	4.16	4.48
29	4.47	......	9.45	6.60	5.16	4.22	3.50	3.34	3.64	3.90	4.12	4.69
30	4.42	......	10.28	6.44	6.80	4.32	3.50	3.31	3.65	3.89	4.03	4.58
31	4.38	......	12.75	......	6.93	......	3.50	3.39	......	3.90	......	4.50

NOTE.—River frozen two-thirds across November 22. Ice conditions until December 20. Ice attained a maximum thickness of 10 inches.

Rating table for Malheur River at Vale, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	5	4.40	195	5.50	810	6.70	1,840	8.80	4,330
3.30	9	4.50	235	5.60	880	6.80	1,940	9.00	4,600
3.40	14	4.60	280	5.70	955	6.90	2,045	9.20	4,870
3.50	21	4.70	325	5.80	1,030	7.00	2,150	9.40	5,150
3.60	29	4.80	375	5.90	1,110	7.20	2,370	9.60	5,430
3.70	39	4.90	430	6.00	1,190	7.40	2,595	9.80	5,710
3.80	52	5.00	490	6.10	1,275	7.60	2,825	10.00	6,000
3.90	67	5.10	550	6.20	1,360	7.80	3,060	11.00	7,470
4.00	85	5.20	610	6.30	1,450	8.00	3,300	12.00	8,970
4.10	105			6.40	1,545	8.20	3,550	13.00	10,570
4.20	130	5.30	675	6.50	1,640	8.40	3,810	14.00	12,220
4.30	160	5.40	740	6.60	1,740	8.60	4,070		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 12 discharge measurements made during 1906 and is well defined between gage heights 4.4 feet and 11.0 feet.

Monthly discharge of Malheur River at Vale, Oreg., for 1906.

[Drainage area, 4,860 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	302	115	174	10,700	0.036	0.04
February	817	151	311	17,300	.064	.07
March	10,200	258	1,920	118,000	.395	.46
April	12,800	1,580	4,550	271,000	.936	1.04
May	2,080	298	862	53,000	.177	.20
June	1,510	136	589	35,000	.121	.14
July	160	5	49.7	3,060	.010	.01
August	17	4	8.6	529	.0018	.002
September	35	14	25.7	1,530	.0053	.01
October	74	37	50.5	3,110	.010	.01
November	120	64	89.3	5,310	.018	.02
December	320	78	138	8,480	.028	.03
The year	12,800	4	731	527,000	.150	2.03

NOTE.—Values are rated as follows: January, November, and December, good; February to June, excellent; July, September, and October, fair; August, approximate.

MIDDLE FORK OF MALHEUR RIVER AT RIVERSIDE, OREG.

This station was established January 24, 1906, and was discontinued December 31, 1906, on account of the expense of maintenance. It was located one-half mile above Riverside post-office, and 200 feet above the mouth of South Fork.

The channel is straight; the banks are high and steep. The bed is of gravel and liable to change. There is one channel at all stages.

Discharge measurements were made from a cable.

A chain gage, which was read by J. C. Bloylock, was installed May 8, 1906; length of chain, 15.12 feet. Gage heights previous to this were reduced to the same datum. The bench mark is the highest point of a rock on the left bank near the cable supports, marked B. M.; elevation, 19.41 feet above the gage datum.

The following measurement was made May 9, 1906:

Width, 86 feet; area, 156 feet; gage height, 2.18 feet; discharge, 495 second-feet.

Daily gage height, in feet, of Middle Fork of Malheur River at Riverside, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.9		6.75	2.2	2.2	1.4	0.6	0.6	0.9	0.9	1.2
2		1.9			2.2	2.1	1.4	.6	.6	.9	1.1	1.2
3	1.9	1.6			2.2	2.1	1.4	.6	.6	.9	1.1	1.3
4	1.9	1.6		6.35	2.2	2.9	1.3	.5	.6	.9	1.1	1.2
5	1.9	1.7			2.2	2.3	1.2	.5	.6	.9	1.1	1.3
6	1.9	1.8			2.2	2.2	1.2	.5	.6	.9	1.1	1.2
7	1.0	1.8			2.2	2.2	1.1	.5	.6	.9	1.1	1.2
8	1.9	1.7		6.35	2.1	2.1	1.1	.5	.6	.9	1.1	1.2
9	1.9	1.7		6.35	2.2	2.1	1.1	.5	.6	.9	1.1	1.2
10	1.8	1.8	2.0	6.35	2.2	2.1	1.1	.5	.6	1.9	1.1	1.2
11	2.9	1.8	1.9	6.35	2.2	2.1	1.0	.5	.6	1.0	1.1	1.2
12	2.1	1.9	1.8		2.1	2.9	1.0	.5	.6	1.9	1.1	1.2
13	2.1	1.9	1.7		2.2	2.0	1.9	.5	.6	1.2	1.1	1.2
14	2.1	1.8	1.6		2.1	1.9	1.9	.5	.7	1.2	1.1	1.1
15	2.1	1.85			2.1	1.9	.9	.5	.8	.9	1.1	1.2
16	2.1	1.9			2.1	1.9	.9	.55	.7	.9	1.1	1.2
17	2.1	1.7			2.9	1.8	1.9	.5	.7	1.9	1.2	1.2
18	2.2	1.7			2.9	1.8	1.9	.5	.7	1.9	1.2	1.2
19	2.3	1.7			1.9	1.7	.9	.5	.7	1.0	1.2	1.2
20	2.3	1.6		3.3	1.8	1.7	.9	.5	.7	1.9	1.2	1.2
21	2.4	1.7		3.5	1.8	1.6	.9	.5	.7	1.0	1.1	1.2
22	2.9	1.6	1.8	3.4	1.7	1.6	.9	.5	.8	1.0	1.1	1.2
23		1.3	2.1	3.4	1.7	1.6	.9	.5	.8	1.9	1.4	1.2
24	2.0	1.1	3.75	3.9	1.7	1.5	.9	.5	.8	1.9	1.5	1.2
25	2.0	1.1	4.1	2.9	1.7	1.4	.8	.5	.8	1.0	1.4	1.3
26	2.9		3.8	2.9	1.6	1.4	.8	.5	.8	1.9	1.4	1.7
27	2.1		4.15	2.7	1.8	1.6	.8	.5	.8	1.0	1.3	1.8
28	2.1		4.2	2.6	2.1	1.5	.8	.5	.9	1.9	1.2	1.6
29	2.0		4.2	2.4	2.5	1.4	.7	.6	.9	1.9	1.2	1.5
30	2.0		6.75	2.2	2.8	1.5	.7	.6	.9	1.0	1.2	1.5
31	1.9				2.5		.7	.6		.9		1.3

BULLY CREEK ABOVE VALE, OREG.

This station was established January 27, 1905. It is near the location of the original station on Bully Creek, one-fourth mile below Warm Springs stage station, 15 miles above Vale, Oreg. To replace the former bench mark, which had been destroyed, a new one was established May 6, 1906, as follows: A small shoulder cut in rock on upper side of road 6.2 feet upstream from gage; elevation, 6.82 feet above gage datum. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 137, where are given also references to publications that contain data for previous years.

Discharge measurements of Bully Creek above Vale, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 28	R. S. Hall	13	6.7	2.03	7.8
March 26	do	77	128	3.98	579
March 27	do	78	176	4.60	1,100
March 28	do	79	151	4.19	826
March 29	do	79	172	4.58	1,019
April 10	do	78	123	3.88	704
April 11	do	68	115	3.70	567
May 5	do	39	43	2.00	52
June 15	do	33	35	1.70	20

Daily gage height, in feet, of Bully Creek above Vale, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.18	2.18	2.14	5.00	2.50	2.18	1.46	1.30	1.30	1.30	1.30	1.50
2	2.18	2.20	2.14	4.20	2.40	2.12	1.50	1.30	1.30	1.30	1.30	1.50
3	2.16	2.24	2.16	4.00	2.30	2.12	1.50	1.30	1.30	1.30	1.30	1.50
4	2.15	2.26	2.18	3.70	2.20	2.14	1.50	1.30	1.30	1.30	1.30	1.50
5	2.12	2.28	2.20	4.20	2.00	2.18	1.50	1.30	1.30	1.30	1.30	1.52
6	2.12	2.30	2.20	4.50	2.00	2.18	1.50	1.30	1.30	1.30	1.30	1.52
7	2.12	2.26	2.30	4.30	1.96	2.18	2.00	1.30	1.30	1.30	1.32	1.52
8	2.14	2.20	2.36	4.00	1.90	2.10	1.80	1.30	1.30	1.30	1.32	1.54
9	2.14	2.10	2.65	4.30	1.80	2.00	1.70	1.30	1.30	1.30	1.34	1.54
10	2.16	2.08	2.80	3.80	1.76	1.90	1.60	1.30	1.30	1.30	1.34	1.56
11	2.16	2.00	2.60	3.60	2.10	1.86	1.52	1.30	1.30	1.30	1.36	1.56
12	2.16	2.00	2.60	3.50	2.18	1.84	1.50	1.30	1.30	1.30	1.40	1.56
13	2.16	2.00	2.60	3.30	2.18	1.80	1.44	1.30	1.30	1.30	1.44	1.54
14	2.16	2.08	2.58	3.30	2.10	1.70	1.40	1.30	1.30	1.30	1.46	1.54
15	2.14	2.10	2.54	3.20	2.00	1.60	1.40	1.30	1.30	1.30	1.46	1.54
16	2.14	2.10	2.40	3.20	2.00	1.64	1.40	1.30	1.30	1.30	1.48	1.52
17	2.12	2.10	2.40	3.10	1.90	1.70	1.40	1.30	1.30	1.30	1.48	1.52
18	2.12	2.10	2.40	3.10	1.90	1.70	1.40	1.30	1.30	1.30	1.48	1.54
19	2.10	2.10	2.50	3.00	1.80	1.70	1.40	1.30	1.30	1.30	1.50	1.54
20	2.08	2.10	2.50	3.00	1.80	1.68	1.40	1.30	1.30	1.30	1.50	1.54
21	2.06	2.10	2.54	3.00	1.80	1.68	1.40	1.30	1.30	1.30	1.50	1.56
22	2.08	2.10	2.80	3.00	1.78	1.66	1.40	1.30	1.30	1.30	1.50	1.56
23	2.08	2.10	3.00	2.80	1.78	1.64	1.40	1.30	1.30	1.30	1.50	1.56
24	2.10	2.10	4.30	2.80	1.74	1.64	1.38	1.30	1.30	1.30	1.50	1.56
25	2.10	2.10	4.10	2.80	1.74	1.60	1.36	1.30	1.30	1.30	1.50	1.56
26	2.10	2.10	4.10	2.60	1.72	1.60	1.34	1.30	1.30	1.30	1.50	1.56
27	2.10	2.12	4.50	2.60	1.72	1.58	1.30	1.30	1.30	1.30	1.50	1.56
28	2.12	2.10	4.30	2.60	1.72	1.58	1.30	1.30	1.30	1.30	1.50	1.56
29	2.12	....	4.30	2.60	1.80	1.56	1.30	1.30	1.30	1.30	1.50	1.56
30	2.14	....	4.90	2.50	2.20	1.50	1.30	1.30	1.30	1.30	1.50	1.54
31	2.16	....	6.10	....	2.20	....	....	1.30	....	1.30	....	1.52

NOTE.—Creek was frozen December 12 to 31; discharges not corrected.

Rating tables for Bully Creek above Vale, Oreg.

JANUARY 1 TO MARCH 31, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	0.0	2.40	42	3.20	238	4.00	620	4.80	1,195
1.70	.3	2.50	56	3.30	274	4.10	680	4.90	1,275
1.80	2	2.60	74	3.40	313	4.20	745	5.00	1,360
1.90	6	2.70	96	3.50	355	4.30	815	5.20	1,540
2.00	11	2.80	120	3.60	400	4.40	885	5.40	1,750
2.10	17	2.90	146	3.70	450	4.50	960	5.60	1,980
2.20	24	3.00	174	3.80	505	4.60	1,035	5.80	2,230
2.30	32	3.10	205	3.90	560	4.70	1,115	6.00	2,500

APRIL 1 TO DECEMBER 31, 1906.[b]

1.30	3	2.00	50	2.70	190	3.40	425	4.20	845
1.40	4	2.10	65	2.80	215	3.50	470	4.40	975
1.50	7	2.20	80	2.90	245	3.60	515	4.60	1,110
1.60	12	2.30	100	3.00	275	3.70	565	4.80	1,250
1.70	19	2.40	120	3.10	310	3.80	615	5.00	1,400
1.80	28	2.50	140	3.20	345	3.90	670		
1.90	38	2.60	165	3.30	385	4.00	725		

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is not well defined.

[b] This table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is fairly well defined.

Monthly discharge of Bully Creek above Vale, Oreg., for 1906.

[Drainage area, 650 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	23	15	18.9	1,160	0.029	0.03
February	32	11	19.2	1,070	.030	.03
March	2,640	20	324	19,900	.498	.57
April	1,400	140	473.0	28,100	.728	.81
May	140	21	50.6	3,110	.078	.09
June	77	7	33.7	2,010	.052	.06
July	50	3	7.61	468	.012	.01
August	3	3	3.0	184	.0046	.01
September	3	3	3.0	179	.0046	.01
October	3	3	3.0	184	.0046	.01
November	7	3	5.23	311	.0080	.01
December	10	7	8.94	550	.014	.02
The year	2,640	3	79.2	57,200	.122	1.66

NOTE.—Values are rated as follows: January to March and July to December, approximate; April to June, good.

BULLY CREEK AT VALE, OREG.

This station was discontinued as a permanent gaging station on December 31, 1905. The conditions and the bench marks are described in Water-Supply Paper No. 178, page 140, where are given also references to publications that contain data for previous years.

A number of measurements were made during 1906, as follows:

Discharge measurements of Bully Creek at Vale, Oreg., in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.	Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 29	15	6.7	3.22	8.5	March 24	45	97	5.52	435
February 15	14	8.3	3.30	11	November 28[a]				3
March 3	14	10	3.36	16					

[a] Estimated at low water; frozen.

WILLOW CREEK NEAR MALHEUR, OREG.

This station was established November 4, 1904, and was discontinued August 15, 1906. It is located at Beer's ranch, about 5 miles from Malheur, on the road to Huntington, Oreg. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 141, where are given also references to publications that contain data for previous years.

The following measurement was made April 5, 1906:

Width, 36 feet; area, 79 square feet; gage height, 4.75 feet; discharge, 355 second-feet.

Daily gage height, in feet, of Willow Creek near Malheur, Oreg., for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Day.	Mar.	Apr.	May.	June.	July.	Aug.
1	......	5.0	1.9	1.9	1.0	0.2	17	......	2.9	0.8	1.5	......	......
2	......	4.0	1.9	1.8	1.0	......	18	......	2.9	.8	1.25	......	......
3	......	3.9	1.8	1.8	1.0	......	19	......	2.7	.8	1.0	......	......
4	......	5.0	1.5	1.7	......	.2	20	......	2.8	1.3	.9	0.4	......
5	......	5.1	1.3	1.7	.7	.2	21	......	2.7	1.4	.95	.4	......
6	......	5.1	1.3	1.8	.7	.2	22	......	2.6	1.4	.5	.4	......
7	......	5.1	1.2	1.9	.7	.2	23	1.3	2.6	1.8	.6	.4	......
8	......	4.7	1.2	1.9	.7	.2	24	3.8	2.5	1.8	.5	......	......
9	......	4.3	1.2	1.9	.7	.2	25	2.5	2.5	1.9	.5	......	......
10	......	4.0	1.2	1.3	.7	.2	26	2.5	2.5	1.9	.8	......	......
11	......	3.7	1.0	1.4	.65	......	27	3.0	2.5	1.9	.9	.4	......
12	......	3.3	1.0	......	.65	......	28	3.0	2.4	1.9	.9	.3	......
13	......	3.0	1.0	......	.65	.2	29	3.5	2.3	1.9	.8	.3	......
14	......	2.9	.9	1.3	.8	.2	30	4.1	2.1	1.9	1.0	......	......
15	......	2.9	.9	1.3	.7	......	31	4.7	......	1.9	......	......	......
16	......	2.9	.9	1.3	.55	......							

Rating table for Willow Creek near Malheur, Oreg., for 1906.

Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.	Gage height.	Dis-charge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	0	1.10	16	2.00	64	2.90	137	3.80	235
.30	.5	1.20	20	2.10	71	3.00	147	3.90	247
.40	1.2	1.30	24	2.20	78	3.10	157	4.00	259
.50	2.2	1.40	29	2.30	86	3.20	167	4.20	283
.60	3.5	1.50	34	2.40	94	3.30	178	4.40	309
.70	5.0	1.60	39	2.50	102	3.40	189	4.60	335
.80	7.0	1.70	45	2.60	110	3.50	200	4.80	361
.90	9.5	1.80	51	2.70	119	3.60	211	5.00	388
1.00	12.5	1.90	57	2.80	128	3.70	223		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and is fairly well defined below gage height 2 feet.

Monthly discharge of Willow Creek near Malheur, Oreg., for 1906.

[Drainage area, 259 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
March 23-31	348	24	175	3,120	0.676	0.23
April	402	71	196	11,700	.757	.84
May	57	7	32.2	1,980	.124	.14
June	57	2.2	26.5	1,580	.102	.11
July	12.5	0	3.90	240	.015	.02
August 1-14	0	0	0	0	0	0
The period				18,600		

NOTE.—Values are rated as good.

WILLOW CREEK NEAR DELL, OREG.

This station was established May 12, 1904, and was discontinued July 16, 1906, on account of unfavorable conditions. It is located at a bridge at Cole's ranch near Dell, Oreg., 28 miles above Vale. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 143, where are given also references to publications that contain data for previous years.

Discharge measurements of Willow Creek near Dell, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 5[a]	R. S. Hall	8.7	6.1	2.00	10
March 27	do	63	173	5.80	371
March 27	do	62	132	5.00	261
March 28	do	54	91	4.53	175
April 25	do	45	57	4.17	108
June 15	do	46	24	3.11	36

[a] Measured by wading.

Daily gage height, in feet, of Willow Creek near Dell, Oreg., for 1906.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Feb.	Mar.	Apr.	May.	June.	July.
1	......	2.2	6.75	3.4	3.4	2.7	17	......	3.0	4.5	3.0	3.1	2.5
2	......	2.2	6.5	3.4	3.6	2.7	18	......	3.1	4.4	2.6	3.0	2.5
3	......	2.3	5.75	3.2	4.0	2.75	19	......	2.9	4.4	2.75	3.0	......
4	......	2.2	5.9	3.3	4.0	2.5	20	......	3.1	4.4	2.6	3.0	......
5	......	2.1	6.4	3.1	3.7	2.6	21	2.1	3.0	4.5	2.9	2.9	......
6	......	2.1	6.1	3.0	3.7	2.6	22	2.15	2.6	4.6	3.0	2.9	......
7	......	2.2	6.0	2.9	3.6	2.6	23	2.2	3.1	4.4	3.6	2.8	......
8	......	2.6	6.1	3.1	3.5	2.5	24	2.2	5.8	4.5	3.7	2.6	......
9	......	2.8	6.0	3.0	3.6	2.6	25	2.2	5.6	4.5	4.0	2.5	......
10	......	2.7	5.9	3.2	3.6	2.5	26	2.1	5.2	4.0	4.1	3.1	......
11	......	2.5	5.6	4.0	3.7	2.6	27	2.2	6.15	4.2	4.0	2.8	......
12	......	2.6	5.4	4.2	3.5	2.6	28	2.1	5.6	4.0	4.1	2.8	......
13	......	2.4	5.5	4.2	3.4	2.6	29	......	6.0	3.6	4.0	2.75	......
14	......	2.1	5.4	4.2	3.3	2.5	30	......	5.5	3.5	3.4	2.8	......
15	......	2.4	5.1	3.0	3.2	2.6	31	......	6.8	......	3.7	......	......
16	......	3.0	4.6	3.0	3.15	2.5							

Rating table for Willow Creek near Dell, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	7	2.90	32	3.70	79	4.50	156	5.60	345
2.20	9	3.00	37	3.80	87	4.60	168	5.80	395
2.30	11	3.10	42	3.90	95	4.70	181	6.00	445
2.40	14	3.20	47	4.00	104	4.80	195	6.20	500
2.50	17	3.30	53	4.10	113	4.90	210	6.40	560
2.60	20	3.40	59	4.20	123	5.00	225	6.60	620
2.70	24	3.50	65	4.30	133	5.20	260	6.80	680
2.80	28	3.60	72	4.40	144	5.40	300		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1906, and is fairly well defined.

Monthly discharge of Willow Creek near Dell, Oreg., for 1906.

[Drainage area, 455 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
February 21-28	9	7	8.12	129	0.018	0.01
March	680	7	122	7,500	.268	.31
April	665	65	279	16,600	.613	.68
May	123	20	64.5	3,970	.142	.16
June	104	17	52.0	3,090	.114	.13
July 1-18	26	17	19.6	700	.043	.03
The period				32,000		

NOTE.—Values are rated as fair.

POWDER RIVER AT SALISBURY, OREG.[a]

This station was established December 20, 1903. It is located 10 miles above Baker City, Oreg., and one-fourth mile below Salisbury, a station on the Sumpter Valley Railway. The station is above all important diversions and above the point where the river enters the valley which surrounds Baker City. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 148, where are given also references to publications that contain data for previous years.

Discharge measurements of Powder River at Salisbury, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 9[a]	R. S. Hall	27	24	2.25	45
March 9[a]	do	24	23	2.28	48
April 14	do	40	88	3.80	368
April 23	do	43	119	4.55	655
May 14	do	40	79	3.60	321
June 12	do	41	74	3.42	297
November 30[b]	Stevens and McGlashan	35	32	2.38	25

[a] Slush ice running.
[b] Ice measurement; 15 feet of open channel.

Daily gage height, in feet, of Powder River at Salisbury, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	2.05	2.15	4.05	4.15	3.35	2.65	2.0	1.8	1.8	1.95	2.5
2	2.1	2.05	2.15	4.2	4.05	3.25	2.55	2.05	1.75	1.75	2.0	2.35
3	2.05	2.1	2.15	3.55	4.15	3.3	2.6	1.85	1.75	1.7	2.1	2.35
4	2.05	2.1	2.15	3.65	4.25	3.4	2.45	1.85	1.75	1.75	2.15	2.45
5	2.05	2.1	2.15	4.3	4.15	3.5	2.4	1.8	1.75	1.8	2.25	2.45
6	2.05	2.15	2.15	4.95	3.75	3.5	2.35	1.9	1.7	1.75	2.25	2.45
7	2.05	2.15	2.15	5.0	4.05	3.4	2.35	1.85	1.75	1.8	2.2	2.5
8	2.05	2.15	2.2	4.5	4.05	3.4	2.35	1.9	1.75	1.8	2.3	2.5
9	2.1	2.2	2.2	4.25	4.05	3.3	2.3	1.85	1.8	1.7	2.25	2.45
10	2.1	2.2	2.25	4.1	3.85	3.4	2.25	1.8	1.7	1.75	2.2	2.45
11	2.1	2.2	2.15	4.2	3.7	3.35	2.25	1.85	1.8	1.75	2.25	2.55
12	2.1	2.2	2.1	3.95	3.7	3.45	2.25	1.85	1.85	1.75	2.35	2.45
13	2.1	2.2	2.1	3.9	3.65	3.4	2.8	1.75	1.75	1.8	2.35	2.45
14	2.05	2.25	2.2	4.05	3.55	3.35	2.25	1.7	1.8	1.75	2.25	2.55
15	2.05	2.25	2.25	4.15	3.35	3.25	2.3	1.75	1.75	1.75	2.15	2.5
16	2.05	2.3	2.25	4.25	3.4	3.35	2.25	1.7	1.75	1.85	2.05	2.65
17	2.0	2.35	2.2	4.05	3.15	3.35	2.2	1.65	1.75	1.85	2.05	2.65
18	2.0	2.35	2.25	4.15	3.05	3.25	2.1	1.65	1.75	1.8	2.05	2.65
19	2.1	2.35	2.35	3.95	3.05	3.25	2.1	1.65	1.75	1.7	1.95	2.45
20	2.15	2.4	2.45	4.05	3.15	3.05	2.05	1.75	1.75	1.8	2.10	2.3
21	2.15	2.45	2.4	4.05	3.15	3.15	2.1	1.8	1.7	1.8	2.15	2.35
22	2.15	2.45	2.45	4.7	3.15	3.1	2.05	1.75	1.75	1.8	2.25	2.45
23	2.1	2.45	2.45	4.55	3.15	3.05	2.1	1.85	1.75	1.8	2.3	2.45
24	2.1	2.4	2.65	4.45	3.05	2.95	2.05	1.85	1.75	1.9	2.4	2.5
25	2.1	2.25	3.0	4.25	3.05	3.1	2.0	1.75	1.7	1.95	2.3	2.6
26	2.1	2.2	3.15	4.1	3.15	3.15	2.05	1.75	1.75	1.95	2.3	2.65
27	2.1	2.1	3.5	3.6	3.1	3.05	2.05	1.7	1.75	1.95	2.3	2.65
28	2.15	2.15	3.5	3.55	3.25	2.95	2.05	1.8	1.8	1.9	2.25	2.55
29	2.15	....	3.6	3.45	3.15	2.85	2.0	1.75	1.8	1.9	2.8	2.45
30	2.1	....	4.2	3.95	3.15	2.7	1.9	1.75	1.7	1.85	2.4	2.45
31	2.1	....	4.55	....	3.25	....	1.9	1.75	....	1.85	....	2.4

NOTE.—The river was frozen January 1 to about February 24 and November 19 to December 31. The gage heights of this stream vary somewhat during the day on account of placer mining upstream.

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[a] Formerly known as Powder River near Baker City.

Rating tables for Powder River at Salisbury, Oreg.

OPEN-CHANNEL CONDITIONS, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	4	2.20	38	2.80	120	3.40	267	4.00	469
1.70	7	2.30	48	2.90	140	3.50	299	4.20	537
1.80	11	2.40	60	3.00	161	3.60	333	4.40	605
1.90	16	2.50	72	3.10	184	3.70	367	4.60	673
2.00	22	2.60	86	3.20	209	3.80	401	4.80	741
2.10	30	2.70	102	3.30	237	3.90	435	5.00	810

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1906, and is well defined between gage heights 1.7 feet and 4.6 feet.

ICE CONDITIONS, 1906.[b]

1.95	9	2.10	15	2.30	23	2.50	32	2.70	42
2.00	11	2.20	19	2.40	27	2.60	37		

[b] This table is applicable only for ice conditions. It is based on 3 discharge measurements made at times of ice obstruction during 1904-1906, and is not well defined.

Monthly discharge of Powder River at Salisbury, Oreg., for 1906.

[Drainage area, 275 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	17	11	14.5	892	0.053	0.06
February	43	13	23.1	1,280	.084	.09
March	656	30	114	7,010	.415	.48
April	810	283	513	30,500	1.87	2.09
May	554	172	312	19,200	1.13	1.30
June	299	102	222	13,200	.807	.90
July	94	16	41.8	2,570	.152	.18
August	26	5	11.1	682	.040	.05
September	13	7	9.2	547	.033	.04
October	19	7	11.6	713	.042	.05
November	54	9	30.5	1,810	.111	.12
December	40	23	31.7	1,950	.115	.13
The year	810	5	111	80,400	.404	5.49

NOTE.—Values are rated as follows: January, February, November, and December, fair; March to October, good.

GRANDE RONDE RIVER AT HILGARD, OREG.

This station was established November 6, 1903. It is located at the county highway bridge one-half mile below the Oregon Railroad and Navigation Company station at Hilgard, Oreg. It is just below the mouth of Five Points Creek, which is the first important tributary above Grande Ronde Valley. There are two dams about 20 miles upstream, used to flood the river during the log-driving season. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 150, where are given also references to publications that contain data for previous years.

Gage heights observed during 1906 are of no value as an index of discharge, on account of obstruction and backwater from log jams.

Discharge measurements of Grande Ronde River at Hilgard, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 10	R. S. Hall	108.5	371	5.18	74
April 3	do	102	378	4.88	1,14
May 16[a]	do	70	370	6.74	65
June 22	do	70	242	3.74	2
December 4[b]	Stevens and McGlashan	70	181	3.02	66

[a] Backwater from log jam. [b] Ice measurements.

GRANDE RONDE RIVER AT ELGIN, OREG.

This station was established November 20, 1903. It is located at the lower end of the Grande Ronde Valley at the county bridge on the road from Elgin to Wallowa, Oreg., and is one-fourth mile east of the railroad station. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 153, where are given also references to publications that contain data for previous years.

Discharge measurements of Grande Ronde River at Elgin, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 18	R. S. Hall	95	367	3.34	1,030
June 29	do	94	334	2.93	666
December 10[a]	Stevens and McGlashan	90	310	2.20	290

[a] Narrow strip of ice on each bank.

Daily gage height, in feet, of Grande Ronde River at Elgin, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	2.0	2.55	5.45	4.2	5.75	3.0	1.55	1.5	1.7	......	2.05
2	1.85	1.9	2.5	5.4	4.2	5.75	2.6	1.55	1.5	1.7	1.85	2.05
3	1.9	1.95	2.45	5.2	4.2	5.8	2.6	1.5	1.5	1.7	1.85	2.0
4	1.95	1.95	2.45	5.0	4.15	5.75	2.6	1.55	1.5	1.7	1.9	2.0
5	1.85	1.9	2.45	4.8	4.0	5.7	2.5	1.55	1.5	1.7	2.0	2.0
6	1.9	1.95	2.4	4.7	3.95	5.5	2.5	1.55	1.5	1.7	2.0	2.05
7	1.9	2.0	2.45	4.75	3.95	5.5	2.45	1.55	......	1.7	2.0	2.1
8	1.9	1.95	2.9	4.9	3.8	5.45	2.35	1.55	1.5	1.7	2.05	2.2
9	1.85	1.9	3.1	5.0	3.75	5.3	2.5	1.5	1.5	1.7	2.05	2.2
10	1.9	1.9	3.45	5.1	3.7	5.1	2.35	1.5	1.5	1.7	2.05	2.25
11	1.9	......	3.5	5.0	3.75	4.9	......	1.5	1.5	1.7	......	2.3
12	2.0	1.9	3.25	4.85	3.7	4.3	2.1	1.55	1.55	1.7	......	......
13	1.9	1.9	2.9	4.7	3.7	4.5	2.0	1.5	1.0	1.75	2.05	2.3
14	1.95	1.95	2.65	4.5	3.6	4.3	2.0	1.5	1.65	1.75	2.2	2.25
15	1.95	2.0	2.5	4.7	3.6	4.2	1.9	1.5	1.7	......	2.5	2.1
16	2.0	2.05	2.6	4.5	3.0	4.2	1.9	1.5	1.7	1.75	2.6	2.1
17	2.0	2.2	2.5	4.5	3.6	4.2	1.85	1.5	1.75	1.8	2.0	......
18	2.0	2.65	2.45	4.5	3.45	4.05	1.85	1.5	1.8	1.8	2.5	2.15
19	1.95	2.6	2.45	4.5	3.2	3.85	1.8	1.5	1.8	1.8	2.35	2.25
20	1.95	2.85	2.45	4.5	3.15	3.75	......	1.5	1.8	1.75	2.3	2.7
21	1.9	2.8	2.4	4.5	3.0	3.6	1.7	1.5	1.8	1.8	2.1	3.1
22	1.95	2.8	2.5	4.7	3.0	3.5	1.65	1.5	1.75	1.8	2.0	3.1
23	1.95	2.75	2.8	4.9	3.0	3.3	1.65	1.5	1.75	1.8	2.2	3.3
24	2.0	2.65	3.8	4.8	3.0	3.25	1.65	1.5	1.7	1.8	2.1	3.45
25	2.1	2.65	4.2	4.75	3.0	3.2	1.65	1.5	1.7	1.8	2.1	3.9
26	......	2.6	4.5	4.6	3.0	3.1	......	1.5	1.7	1.8	2.1	4.3
27	2.2	2.7	4.8	4.5	2.9	3.0	1.65	1.5	1.7	......	2.1	4.4
28	2.1	2.65	4.9	......	2.9	3.1	1.65	1.5	1.7	1.8	2.1	4.35
29	2.0	......	......	4.35	3.3	3.0	1.6	1.5	1.75	1.8	1.95	4.0
30	2.0	......	5.1	4.1	4.45	2.9	1.0	1.5	1.75	1.8	2.0	3.85
31	1.95	......	5.45	......	4.7	......	1.0	1.5	......	1.8	......	3.7

NOTE.—There was some ice obstruction during November and December.

Rating table for Grande Ronde River at Elgin, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	45	2.20	260	2.90	640	3.60	1,340	4.60	3,020
1.60	67	2.30	305	3.00	710	3.70	1,480	4.80	3,380
1.70	92	2.40	350	3.10	790	3.80	1,630	5.00	3,740
1.80	120	2.50	400	3.20	880	3.90	1,790	5.20	4,100
1.90	150	2.60	455	3.30	980	4.00	1,960	5.40	4,460
2.00	185	2.70	515	3.40	1,090	4.20	2,300	5.60	4,820
2.10	220	2.80	575	3.50	1,210	4.40	2,660	5.80	5,200

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1904–1906 and is well defined below gage height 3.5 feet.

Monthly discharge of Grande Ronde River at Elgin, Oreg., for 1906.

[Drainage area, 1,350 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	260	135	172	10,600	0.127	0.15
February	608	150	293	16,300	.217	.23
March	4.550	350	1,230	75,600	.911	1.05
April	4,550	2,130	3,270	195,000	2.42	2.70
May	3,200	640	1,440	88,500	1.07	1.23
June	5,200	640	2,670	159,000	1.98	2.21
July	710	67	220	13,500	.163	.19
August	56	45	47.8	2,940	.035	.04
September	120	45	78.4	4,670	.058	.06
October	120	92	107	6,580	.079	.09
November	455	128	235	14,000	.174	.19
December	2,660	185	756	46,500	.560	.65
The year	5,200	45	877	603,000	.650	8.79

NOTE.—Discharges have been interpolated for days when the gage was not read. November and December have been applied as for open channel. Values are rated as follows: January, February, July, and October to December, fair; March to June, good; August and September, approximate.

GRANDE RONDE RIVER AT ZINDEL, WASH.

This station was established June 30, 1904. It is located at Zindel Ferry, 2 miles above the mouth of the river and 1½ miles below Joseph Creek. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 155, where are given also references to publications that contain data for previous years.

The following measurement was made by floats December 22, 1906:

Width, 224 feet; area, 1,310 square feet; gage height, 5.60 feet; discharge, 8,400 second-feet.

Daily gage height, in feet, of Grande Ronde River at Zindel, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	2.45	3.5	6.4	5.1	5.0	3.9	2.2	2.1	2.1	2.35	3.0
2	2.2	2.3	3.3	6.0	5.1	5.8	3.9	2.2	2.1	2.1	2.35	3.0
3	2.2	2.25	3.3	5.8	5.0	5.7	3.8	2.2	2.1	2.1	2.3	3.0
4	2.3	2.3	3.3	5.5	5.1	5.9	3.8	2.2	2.2	2.2	2.3	3.0
5	2.3	2.35	3.5	5.5	5.0	5.8	3.8	2.2	2.2	2.2	2.3	3.0
6	2.3	2.35	3.5	5.7	4.8	5.8	3.8	2.2	2.2	2.2	2.3	2.9
7	2.3	2.35	3.5	5.9	4.7	5.8	3.8	2.2	2.2	2.2	2.6	2.9
8	2.3	2.3	3.5	5.9	4.7	5.7	3.75	2.2	2.2	2.2	3.35	3.0
9	2.3	2.3	3.9	6.0	4.7	5.7	3.6	2.2	2.2	2.2	3.3	3.1
10	2.3	2.25	4.2	5.9	4.9	5.5	3.6	2.2	2.2	2.2	3.1	3.2
11	2.3	2.25	4.1	5.8	5.1	5.5	3.6	2.2	2.1	2.2	3.0	3.2
12	2.3	2.3	3.9	5.2	5.0	5.7	3.55	2.2	2.1	2.2	3.1	3.4
13	2.35	2.3	3.7	5.2	4.8	5.7	3.5	2.4	2.2	2.2	3.4	3.4
14	2.35	2.3	3.2	5.1	4.7	5.2	3.25	2.2	2.2	2.2	6.85	3.1
15	2.2	2.3	3.2	5.2	4.5	4.9	3.0	2.2	2.2	2.2	6.85	3.1
16	2.2	2.5	3.2	5.3	4.2	5.2	3.0	2.2	2.2	2.25	5.8	3.1
17	2.25	2.5	2.8	5.0	4.2	5.0	3.0	2.2	2.1	2.25	5.1	3.0
18	2.25	2.8	3.0	5.3	4.0	4.8	2.9	2.2	2.1	2.25	4.5	3.0
19	2.3	3.9	2.9	5.3	4.0	4.6	2.8	2.2	2.15	2.25	4.1	3.1
20	2.3	3.9	2.9	5.3	4.0	4.4	2.7	2.2	2.15	2.25	3.9	3.3
21	2.3	3.55	2.9	5.5	4.0	4.3	2.7	2.05	2.15	2.25	3.9	5.65
22	2.3	3.7	3.1	6.0	4.0	4.2	2.6	2.0	2.15	2.25	3.6	5.6
23	2.4	3.8	3.1	6.0	3.0	4.1	2.55	2.0	2.15	2.25	3.5	5.1
24	2.4	3.8	3.4	6.0	3.9	4.0	2.55	2.2	2.15	2.25	3.3	5.1
25	2.5	3.6	4.9	5.6	3.9	3.9	2.4	2.2	2.1	2.25	3.3	4.9
26	2.6	3.45	5.2	5.6	3.8	3.9	2.4	2.2	2.1	2.25	3.1	5.8
27	2.55	3.7	5.6	5.6	3.8	3.8	2.4	2.2	2.1	2.3	3.1	5.9
28	2.4	3.5	5.7	5.4	3.8	3.8	2.3	2.2	2.1	2.45	3.0	5.7
29	2.4	....	5.8	5.0	4.1	3.8	2.3	2.1	2.1	2.45	3.0	5.4
30	2.4	....	5.8	5.1	4.8	3.8	2.3	2.1	2.1	2.4	3.0	5.3
31	2.4	....	6.1	....	5.6	....	2.2	2.1	....	2.4	....	5.0

CATHERINE CREEK NEAR UNION, OREG.

This station was established May 15, 1906. It is located in the canyon at the head of a fertile valley 6 miles above Union.

Discharge measurements are made from a highway bridge just below Robbins's sawmill, where there is a dam that affects the flow somewhat.

The gage is read by H. D. Drake, who is paid by the citizens of Union. It is a vertical staff attached to the downstream side of the bridge. The bench mark is the head of a spike driven into the top of the downstream end of log-tying at the end of the bridge; elevation, 7.67 feet above the datum of the gage.

Discharge measurements of Catherine Creek near Union, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 29	R. S. Hall	38	68	3.20	335
May 15	do	38	68	3.30	375
June 24	do	37.5	61	3.10	275
December 1[a]	Stevens and McGlashan	39	51	2.80	54

[a] Channel obstructed by anchor ice.

Daily gage height, in feet, of Catherine Creek near Union, Oreg., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.5	2.9	2.1	2.1	2.0	2.0	2.5
2		3.7	2.8	2.1	2.1	2.0	2.0	2.6
3		3.8	2.8	2.1	2.1	2.1	2.1	2.6
4		4.0	2.8	2.1	2.0	2.1	2.1	2.8
5		3.9	2.8	2.1	2.0	2.1	2.2	2.5
6		3.8	2.7	2.1	2.0	2.0	2.1	2.3
7		3.7	2.7	2.1	2.0	2.0	2.2	2.3
8		3.5	2.7	2.1	2.0	2.0	2.2	2.2
9		3.5	2.6	2.1	2.0	2.0	2.2	2.2
10		3.5	2.6	2.1	2.0	2.0	2.2	2.2
11		3.6	2.6	2.1	2.0	2.0	2.2	2.3
12		3.6	2.5	2.1	2.0	2.1	2.2	2.3
13		3.5	2.5	2.1	2.1	2.0	3.1	2.2
14		3.4	2.5	2.1	2.1	2.0	3.6	2.2
15	3.3	3.3	2.4	2.1	2.1	2.0	3.0	2.2
16	3.2	3.3	2.4	2.1	2.1	2.0	2.7	2.2
17	3.1	3.3	2.4	2.1	2.1	2.0	2.6	2.2
18	3.0	3.3	2.4	2.1	2.1	2.0	2.5	2.2
19	3.0	3.2	2.4	2.1	2.0	2.0	2.7	2.2
20	3.0	3.1	2.3	2.1	2.0	2.0	2.5	2.3
21	3.0	3.1	2.3	2.1	2.0	2.0	2.5	2.3
22	3.0	3.1	2.3	2.1	2.0	2.0	2.4	2.4
23	3.0	3.0	2.3	2.1	2.0	2.0	2.3	2.5
24	3.0	3.0	2.3	2.1	2.0	2.0	2.2	2.6
25	3.0	3.0	2.3	2.1	2.0	2.0	2.3	2.7
26	3.1	3.0	2.3	2.1	2.0	2.1	2.5	3.0
27	3.1	3.1	2.2	2.1	2.0	2.1	2.5	3.0
28	3.0	3.0	2.2	2.1	2.0	2.0	2.4	2.8
29	3.2	2.9	2.2	2.1	2.0	2.1	2.4	2.7
30	3.3	2.8	2.2	2.1	2.0	2.0	2.4	2.7
31	3.4		2.2	2.1		2.0		2.6

NOTE.—Anchor ice formed in the bed of the stream about December 10 and remained until the end of the year.

WALLOWA RIVER AT JOSEPH, OREG.

This station was established November 12, 1903. It is located 500 feet below the outlet of Wallowa Lake, about 1½ miles above Joseph, Oreg. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 156, where are given also references to publications that contain data for previous years.

Discharge measurements of Wallowa River at Joseph, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 23	R. S. Hall	37.5	64	2.65	247
June 27	do	37.5	75	2.80	336
December 7	Stevens and McGlashan	33	42	2.20	128

Daily gage height, in feet, of Wallowa River at Joseph, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	1.9	2.1	2.9	2.4	2.6	2.8	2.9	2.05	1.8	1.95	2.3
2	1.9	1.9	2.1	2.0	2.4	2.6	2.85	2.9	2.0	1.9	......	2.3
3	1.9	1.9	2.95	1.95	2.4	2.65	2.9	2.95	2.0	1.9	2.0	2.3
4	1.95	1.9	2.9	1.95	2.45	2.6	3.0	2.9	2.0	1.9	2.1	2.3
5	1.95	1.9	2.9	1.95	2.5	2.6	3.9	2.85	2.0	1.85	2.05	2.25
6	1.95	1.9	2.9	1.95	2.2	2.6	3.9	2.8	2.9	1.9	2.05	2.2
7	1.95	1.9	1.95	1.95	2.3	2.6	3.9	2.8	2.0	1.9	2.1	2.2
8	1.95	1.9	2.0	1.95	2.35	2.6	3.9	2.75	2.9	1.9	2.1	2.2
9	1.95	1.9	2.9	2.9	2.4	2.6	3.1	2.7	2.0	1.9	2.1	2.2
19	1.9	1.9	2.9	2.0	2.45	2.7	3.15	2.6	2.0	1.9	2.1	2.2
11	1.9	1.9	2.9	2.9	2.5	2.65	3.15	2.5	2.9	1.9	......	2.2
12	1.9	1.9	......	2.9	2.5	2.6	3.0	2.5	2.5	1.9	2.15	2.2
13	1.9	1.9	2.9	2.9	2.4	2.65	3.9	2.5	2.5	1.9	2.2	2.2
14	1.9	1.9	2.9	2.9	2.35	2.7	3.0	2.5	2.1	1.9	2.3	2.2
15	1.9	1.9	2.9	2.9	2.3	2.7	3.9	2.45	2.1	1.9	2.5	2.2
16	2.9	1.9	1.95	2.9	2.3	2.65	3.05	2.4	2.9	1.9	2.6	2.2
17	1.95	1.9	1.95	2.9	2.4	2.55	2.95	2.4	2.9	1.95	2.6	2.2
18	1.95	1.9	1.95	2.9	2.4	2.6	2.8	2.35	2.9	1.95	2.7	2.15
19	1.95	1.95	1.9	2.9	2.4	2.5	2.8	......	2.9	1.95	2.7	2.1
20	1.95	1.9	1.9	2.1	2.4	2.5	2.85	2.3	2.9	1.95	2.65	2.1
21	1.95	1.95	1.95	2.15	2.4	2.6	2.85	2.3	2.0	1.95	2.65	2.2
22	1.9	1.95	......	2.2	2.4	2.6	2.8	2.25	2.9	1.95	2.6	2.2
23	1.95	1.95	1.95	2.3	2.6	2.7	2.75	2.2	2.0	1.95	2.6	2.2
24	1.95	1.95	1.95	2.8	2.7	2.7	2.8	2.25	......	1.95	2.55	2.2
25	1.95	1.95	1.95	2.3	2.5	2.7	2.8	2.2	2.9	1.95	2.55	2.15
26	1.95	1.95	1.95	2.35	2.7	......	2.85	2.15	1.9	1.9	2.5	2.1
27	1.95	2.1	1.95	2.35	2.8	2.8	2.9	2.1	1.8	1.9	2.45	2.1
28	1.95	2.1	1.95	2.4	2.65	2.85	3.0	2.1	1.85	1.95	2.4	2.15
29	1.9	......	1.95	2.4	2.7	2.85	2.95	2.1	1.85	1.95	2.4	2.2
30	1.9	......	1.95	2.4	2.7	2.85	2.9	2.1	1.8	1.9	2.35	2.15
31	1.9	......	2.9	......	2.6	......	2.9	2.1	......	1.95	......	2.15

NOTE.—The river was not frozen at any time during the year.

Rating table for Wallowa River at Joseph, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.80	26	2.10	77	2.40	170	2.70	299	3.00	464
1.90	35	2.20	104	2.50	209	2.80	350	3.19	527
2.00	54	2.30	135	2.60	252	2.90	405	3.20	597

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined between gage heights 2.0 feet and 2.75 feet.

Monthly discharge of Wallowa River at Joseph, Oreg., for 1906.

[Drainage area, 47 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	54	35	40.5	2,490	0.862	0.99
February	77	35	40.2	2,230	.855	.89
March	77	35	50.1	3,080	1.07	1.23
April	170	44	81.9	4,870	1.74	1.94
May	350	104	201	12,400	4.28	4.93
June	377	209	279	16,600	5.94	6.63
July	561	324	426	26,200	9.06	10.44
August	434	77	208	12,800	4.43	5.11
September	209	26	62.1	3,700	1.32	1.47
October	44	26	38.9	2,340	0.809	.93
November	299	44	159	9,460	3.38	3.77
December	135	77	103	6,330	2.19	2.52
The year	561	26	141	102,000	2.99	40.84

NOTE.—Values are rated as follows: January to March, September, and October, fair; remainder of year, good.

WALLOWA RIVER NEAR WALLOWA, OREG.

This station was established November 14, 1903. It is located at the county bridge, 1½ miles below Wallowa, Oreg., and one-fourth mile below the mouth of Bear Creek. A small irrigation ditch takes water from the river about 300 feet above the bridge on the right bank. During 1906 the gage was read by L. S. Johnson and C. C. Roop. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 159, where are given also references to publications that contain data for previous years.

Discharge measurements of Wallowa River near Wallowa, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 22	R. S. Hall	85	165	2.78	794
June 26	do	85.5	198	3.11	1,120
December 8	Stevens and McGlashan	84	140	2.22	528

Daily gage height, in feet, of Wallowa River near Wallowa, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.75	1.9	2.7	2.8	3.0	3.0	1.9	1.9	1.7	2.0	2.2
2	1.8	1.7	1.8	2.5	2.9	3.1	3.1	1.9	1.9	1.7	1.9	2.2
3	1.8	1.7	1.9	2.5	3.0	3.1	3.2	1.9	1.9	1.7	2.0	2.1
4	1.75	1.65	1.9	2.4	3.3	3.3	3.2	1.9	1.9	1.7	2.0	2.1
5	1.75	1.7	1.9	2.4	3.0	3.2	3.3	1.8	1.8	1.7	2.1	2.1
6	1.8	1.6	1.9	2.5	3.0	3.1	3.2	1.8	1.8	1.7	2.1	2.1
7	1.7	1.8	1.9	2.6	2.9	3.0	3.2	1.8	1.8	1.7	2.1	2.1
8	1.7	2.0	1.95	2.6	2.9	2.9	3.2	1.8	1.8	1.7	2.6	2.2
9	1.8	2.2	2.0	2.7	3.0	2.9	3.1	1.8	1.9	1.8	2.6	2.2
10	1.8	2.0	2.1	2.7	3.2	3.0	3.0	1.7	1.9	1.8	2.6	2.1
11	1.75	2.1	2.0	2.5	3.4	3.3	2.8	1.7	1.9	1.8	2.7	2.2
12	1.75	1.8	1.9	2.5	3.5	3.8	2.7	1.8	1.9	1.8	2.6	2.2
13	1.8	1.9	1.8	2.4	3.1	3.7	2.7	1.9	1.8	1.8	3.5	2.2
14	1.8	1.8	1.9	2.4	3.1	3.4	2.7	1.9	2.0	1.8	4.8	2.1
15	1.7	1.8	1.9	2.4	3.0	3.4	2.6	1.9	2.0	1.9	4.7	2.0
16	1.75	1.8	1.7	2.6	2.8	3.8	2.6	1.8	1.9	1.9	3.8	2.0
17	1.8	1.8	1.7	2.7	2.7	3.5	2.5	1.8	1.9	2.0	3.3	2.0
18	1.8	1.8	1.8	2.7	2.6	3.2	2 4	1.8	1.9	1.9	3.1	2.0
19	1.8	2.0	1.9	2.6	2.5	3.2	2.4	1.8	1.9	1.9	2.9	2.1
20	1.8	1.9	1.8	2.7	2.6	3.2	2.4	1.8	1.9	1.9	2.9	2.3
21	1.8	2.0	1.9	2.9	2.6	3.2	2.4	1.8	1.8	1.9	2.8	2.3
22	1.8	2.0	1.9	3.1	2.8	3.1	2.1	1.8	1.8	1.9	2.7	2.3
23	1.8	2.0	2.0	3.2	2.7	3.2	2.1	1.8	1.8	1.9	2.6	2.3
24	1.8	1.9	2.2	3.0	2.7	3.1	2.0	1.8	1.8	1.9	2.5	2.3
25	1.8	1.9	2.4	2.9	2.7	3.1	2.0	1.9	1.8	1.9	2.5	2.4
26	1.8	1.9	2.4	2.7	2.9	3.2	1.9	1.8	1.8	1.9	2.4	2.6
27	1.7	1.9	2.6	2.8	2.9	3.4	1.9	1.8	1.8	1.9	2.3	2.5
28	1.75	1.9	2.6	2.8	2.9	3.3	1.9	1.8	1.8	2.1	2.3	2.5
29	1.75	......	2.5	2.8	2.9	3.0	1.9	1.8	1.8	2.1	2.3	2.5
30	1.75	......	2.7	2.8	3.0	2.9	1.9	1.9	......	2.0	2,3	2.4
31	1.75	......	2.7	......	3.0	......	1.9	1.9	......	2.0	......	2.3

Rating tables for Wallowa River near Wallowa, Oreg.

JANUARY 1 TO NOVEMBER 14, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	140	2.10	375	2.70	710	3.30	1,290	3.90	1,950
1.60	170	2.20	425	2.80	790	3.40	1,400	4.00	2,070
1.70	205	2.30	475	2.90	880	3.50	1,510	4.20	2,310
1.80	245	2.40	525	3.00	980	3.60	1,620	4.40	2,570
1.90	285	2.50	580	3.10	1,080	3.70	1,730	4.60	2,830
2.00	330	2.60	640	3.20	1,180	3.80	1,840	4.80	3,100

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6, and is well defined between gage heights 1.7 feet and 3.1 feet.

NOVEMBER 15 TO DECEMBER 31, 1906.[b]

1.50	210	2.10	460	2.70	830	3.30	1,330	3.90	1,950
1.60	245	2.20	515	2.80	900	3.40	1,420	4.00	2,070
1.70	285	2.30	570	2.90	980	3.50	1,520	4.20	2,310
1.80	325	2.40	630	3.00	1,060	3.60	1,620	4.40	2,570
1.90	365	2.50	690	3.10	1,150	3.70	1,730	4.60	2,830
2.00	410	2.60	760	3.20	1,240	3.80	1,840		

[b] This table is applicable only for open-channel conditions. It is based on one discharge measurement made during 1906 and the form of previous curves and is not well defined.

Monthly discharge of Wallowa River near Wallowa, Oreg., for 1906.

[Drainage area, 510 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	245	205	233	14,300	0.457	0.53
February	425	170	275	15,300	.539	.56
March	710	205	363	22,300	.712	.82
April	1,180	525	707	42,100	1.39	1.55
May	1,510	580	912	56,100	1.79	2.06
June	1,840	880	1,210	72,000	2.37	2.64
July	1,290	285	687	42,200	1.35	1.56
August	285	205	255	15,700	.500	0.58
September	330	225	267	15,900	.524	0.58
October	375	205	267	16,400	.524	0.60
November	3,100	285	877	52,200	1.72	1.92
December	760	410	530	32,600	1.04	1.30
The year	3,100	170	549	397,000	1.08	14.60

NOTE.—Values are rated as good.

WALLOWA RIVER NEAR ELGIN, OREG.

This station was established November 18, 1903. It is located at the county highway bridge just below the mouth of Minam River, 12 miles from Elgin, Oreg. The station is in Wallowa Canyon about 9 miles below the lower end of Wallowa Valley. The gage was read during 1906 by Tillie Ransom. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 161, where are given also references to publications that contain data for previous years.

Discharge measurements of Wallowa River near Elgin, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 21	R. S. Hall	194	457	3.60	1,580
June 28	do	199	570	4.14	2,480
December 9	Stevens and McOlashan	135	264	2.90	777

Daily gage height, in feet, of Wallowa River near Elgin, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.25	2.25	2.6	2.8	......	4.0	3.9	2.5	2.3	2.25	2.45	2.7
2	2.3	2.3	2.5	2.6	......	4.0	4.0	2.5	2.3	2.25	2.4	2.65
3	2.3	2.3	2.5	3.8	......	4.15	4.0	2.45	2.3	......	2.4	2.65
4	2.25	2.3	2.5	3.8	......	4.5	4.1	2.45	2.3	......	2.45	2.6
5	2.2	2.25	2.5	3.3	......	4.3	4.1	2.45	2.3	......	2.5	2.6
6	2.2	2.25	2.5	3.3	......	4.1	4.0	2.45	2.3	2.25	2.45	2.6
7	2.2	2.25	2.55	3.6	......	4.0	4.0	2.4	2.3	2.25	2.55	2.85
8	2.2	2.2	2.65	3.5	......	3.9	4.0	2.35	2.3	2.25	3.3	2.85
9	2.3	2.2	2.8	3.4	......	3.9	3.8	2.35	2.3	2.25	3.1	2.9
10	2.3	2.25	2.9	3.3	......	4.0	3.7	2.35	2.3	2.25	3.1	2.9
11	2.3	2.3	2.8	3.3	......	4.38	3.6	2.35	2.3	2.25	3.2	2.95
12	2.35	2.3	2.65	3.3	......	4.75	3.6	2.35	2.3	2.3	3.1	3.0
13	2.25	2.3	2.45	3.3	......	4.6	3.4	2.35	2.4	2.3	4.5	3.0
14	2.2	2.4	2.5	3.3	......	4.4	3.3	2.35	2.4	2.3	5.52	2.95
15	2.2	2.4	2.55	3.3	......	4.4	3.3	2.35	2.4	2.3	5.45	2.95
16	2.2	2.35	2.65	3.3	......	4.8	3.2	2.35	2.35	2.35	4.4	2.95
17	2.2	2.35	2.6	3.4	......	4.7	3.1	2.35	2.35	2.4	4.1	2.9
18	2.2	2.4	2.3	3.4	......	4.4	3.1	2.35	2.35	2.4	3.7	2.95
19	2.2	2.7	2.45	3.5	......	4.2	3.0	2.3	2.35	2.35	3.5	2.95
20	2.3	2.7	2.45	3.6	3.6	4.15	2.95	2.3	2.35	2.35	3.45	3.4
21	2.2	2.8	2.5	3.8	3.6	4.25	2.9	2.3	2.3	2.35	3.45	3.7
22	2.2	2.8	2.6	3.8	2.75	4.1	2.85	2.3	2.3	2.3	3.35	3.4
23	2.2	2.7	2.6	3.8	3.65	3.9	2.8	2.3	2.3	2.3	3.3	3.35
24	2.3	2.7	2.9	4.2	3.6	3.9	......	2.4	2.3	2.3	3.25	3.3
25	2.3	2.7	3.4	4.2	3.65	4.0	2.7	2.35	2.3	2.3	3.2	3.3
26	2.3	2.7	3.4	4.0	3.95	4.1	2.6	2.35	2.3	2.3	3.2	3.9
27	2.25	2.7	2.7	3.8	3.9	4.4	2.55	2.3	2.3	2.7	3.1	3.6
28	2.3	2.8	3.4	3.6	3.8	4.4	2.55	2.3	2.3	2.55	3.1	3.55
29	2.3	......	3.5	......	3.85	3.9	2.55	2.3	2.3	2.5	3.0	3.5
30	2.3	......	3.65	......	4.0	3.8	2.55	2.3	2.25	2.5	2.9	3.4
31	2.25	......	2.75	......	4.05	......	2.5	2.3	......	2.45	......	3.3

Rating table for Wallowa River near Elgin, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	215	2.70	615	3.40	1,330	4.10	2,385	4.80	3,700
2.10	255	2.80	695	3.50	1,470	4.20	2,555	4.90	3,920
2.20	300	2.90	780	3.60	1,610	4.30	2,730	5.00	4,140
2.30	350	3.00	870	3.70	1,755	4.40	2,910	5.20	4,600
2.40	405	3.10	970	3.80	1,905	4.50	3,100	5.40	5,090
2.50	470	3.20	1,080	3.90	2,060	4.60	3,300		
2.60	540	3.30	1,200	4.00	2,220	4.70	3,500		

Note.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906 and is well defined below gage height 4.2 feet.

Monthly discharge of Wallowa River near Elgin, Oreg., for 1906.

[Drainage area, 870 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	378	300	326	20,000	0.375	0.43
February	695	300	453	25,200	.521	.54
March	1,830	350	759	46,700	.872	1.01
April 1-28	2,560	540	1,520	84,400	1.75	1.82
May 20-31	2,300	1,610	1,880	44,700	2.16	.96
June	3,700	1,900	2,600	15,500	2.99	3.34
July	2,380	470	1,280	78,700	1.47	1.70
August	470	350	384	23,600	.441	.51
September	405	325	359	21,400	.413	.46
October	615	325	372	22,900	.428	.49
November	5,420	405	1,420	84,500	1.63	1.82
December	2,060	540	1,010	62,100	1.16	1.34
The period				530,000		

Note.—Values are rated as excellent.

ASOTIN CREEK NEAR ASOTIN, WASH.

This station was established March 25, 1904. It is located at Shellman's ranch, about 8 miles above Asotin, Wash. Gage height observations were discontinued during 1906, as no observer was available. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 167, where are given also references to publications that contain data for previous years.

Discharge measurements of Asotin Creek near Asotin, Wash., in 1904 and 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1904.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 25	W. W. Schlecht	35	31	2.03	113
April 22	W. G. Steward	40	70	3.15	458
July 1	do	30	31	1.79	92
August 12	Hulburt and Moore	26	17	1.52	40
1906.					
December 24	H. McGlashan	36	50	2.30	215

Daily gage height, in feet, of Asotin Creek near Asotin, Wash., for 1906.

Day.	Jan.	Feb.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.45	1.55	....	2.0	1.6	1.4	1.4	1.4	1.5
2	1.45	1.55	....	2.0	1.6	1.4	1.4	1.4	1.5
3	1.45	1.55	....	2.0	1.6	1.4	1.4	1.5	1.5
4	1.58	1.55	....	2.1	1.6	1.4	1.4	1.5	1.5
5	1.55	1.55	....	2.1	1.5	1.4	1.4	1.5	1.5
6	1.98	1.55	....	2.1	1.5	1.4	1.4	1.5	1.5
7	1.52	1.55	....	2.0	1.5	1.4	1.4	1.5	1.5
8	1.45	1.55	....	1.9	1.5	1.4	1.4	1.5	1.8
9	1.45	1.55	....	1.9	1.5	1.4	1.4	1.5	1.7
10	1.5	1.55	....	1.8	1.5	1.4	1.4	1.5	1.6
11	1.5	1.55	....	1.8	1.5	1.4	1.4	1.5	1.6
12	1.5	1.55	....	1.8	1.5	1.4	1.4	1.5	1.6
13	1.5	1.55	....	1.8	1.5	1.4	1.4	1.5	1.8
14	1.5	1.55	....	1.8	1.5	1.5	1.4	1.5	2.2
15	1.52	1.55	....	1.8	1.5	1.5	1.4	1.5	2.3
16	1.5	1.55	....	1.8	1.5	1.5	1.4	1.5	2.4
17	1.5	1.62	1.8	1.8	1.5	1.5	1.4	1.5	2.2
18	1.5	....	1.8	1.7	1.5	1.5	1.4	1.5	2.0
19	1.5	....	1.7	1.7	1.5	1.5	1.4	1.5	1.9
20	1.5	....	1.7	1.7	1.5	1.5	1.4	1.5	1.9
21	1.5	....	1.7	1.7	1.5	1.5	1.4	1.5	1.8
22	1.5	....	1.7	1.7	1.5	1.5	1.4	1.5	1.8
23	1.7	....	1.7	1.7	1.5	1.5	1.4	1.5	1.7
24	1.6	....	1.7	1.7	1.5	1.5	1.4	1.5	1.7
25	1.55	....	1.7	1.6	1.5	1.5	1.4	1.5	1.7
26	1.55	....	1.7	1.6	1.5	1.5	1.4	1.5	1.7
27	1.55	....	1.7	1.6	1.5	1.5	1.4	1.5	1.7
28	1.55	....	1.7	1.6	1.5	1.5	1.4	1.5	1.6
29	1.55	....	1.9	1.6	1.5	1.5	1.4	1.5	1.6
30	1.55	....	2.1	1.6	1.5	1.5	1.4	1.5	1.6
31	1.55	....	2.1	....	1.5	1.4	....	1.5	....

Rating table for Asotin Creek near Asotin, Wash., for 1904–1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	29	2.00	126	2.60	277	3.20	502	3.80	829
1.50	40	2.10	147	2.70	309	3.30	549	3.90	894
1.60	54	2.20	169	2.80	343	3.40	599	4.00	962
1.70	70	2.30	193	2.90	379	3.50	652	4.10	1,032
1.80	87	2.40	219	3.00	417	3.60	708	4.20	1,104
1.90	106	2.50	247	3.10	458	3.70	767	4.30	1,179

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1904–1906 and is not well defined.

Monthly discharge of Asotin Creek near Asotin, Wash., for 1904–1906.

[Drainage area, 171 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1904.						
March 21–31	193	116	156	3,400	0.912	0.37
April	1,180	198	469	27,900	2.74	3.06
May	417	219	276	17,000	1.61	1.86
June	277	78	159	9,460	.930	1.04
July	116	50	70.8	4,350	.414	.48
August	54	44	47.0	2,890	.275	.32
September	64	44	47.3	2,810	.277	.31
October	85	47	50.5	3,100	.295	.34
November 1–19	47	47	47.0	1,770	.275	.19
The period				72,700		
1905.						
April	96	62	80.3	4,780	0.470	0.52
May	106	78	91.8	5,640	.537	.62
June	283	54	189	11,200	1.11	1.24
July	70	34	43.1	2,650	.252	.29
August	34	34	34.0	2,090	.199	.23
September	62	34	36.2	2,150	.212	.24
October	47	40	40.7	2,500	.238	.28
November	40	34	39.1	2,330	.229	.26
December	47	34	38.9	2,390	.228	.26
The period				35,700		
1906.						
January	122	34	45.5	2,800	0.266	0.31
February 1–17	57	47	47.6	1,600	.278	.18
May 17–31	147	70	85.0	2,530	.497	.28
June	147	54	89.0	5,300	.520	.58
July	54	40	41.8	2,570	.244	.28
August	40	29	35.0	2,150	.205	.24
September	29	29	29.0	1,730	.170	.19
October	40	29	39.3	2,420	.230	.27
November	219	40	82.5	4,910	.482	.54
The period				26,000		

NOTE.—Values are rated as fair.

PALOUSE RIVER AT HOOPER, WASH.

The gaging station at Hooper, Wash., was originally established April 1, 1897, by the land department of the Northern Pacific Railway. The United States Geological Survey assumed charge September 9, 1897, and moved the station about 1 mile downstream.

The measurements are of value in showing the amount of water available for use on lands of Washtucna Valley and in the section north of Pasco. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 171, where are given also references to publications that contain data for previous years.

Daily gage height, in feet, of Palouse River at Hooper, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	3.6	4.75	5.3	3.2	3.7	1.65	0.9	0.8	0.8	0.9	1.6
2	1.6	3.5	4.7	5.75	3.0	3.5	1.6	.9	.8	.8	.9	1.6
3	1.55	3.6	4.4	6.0	2.4	2.45	1.6	.85	.8	.8	.95	1.6
4	1.5	4.05	4.1	5.85	2.3	2.7	1.6	.8	.8	.8	1.0	1.55
5	1.6	3.5	3.6	5.7	2.15	3.5	1.6	.8	.8	.8	1.0	1.5
6	1.65	3.5	3.9	5.6	2.5	3.05	1.5	.8	.8	.8	1.0	1.65
7	1.7	3.05	3.5	4.4	2.4	2.45	1.4	.8	.8	.8	1.05	1.8
8	1.8	2.9	3.6	4.4	2.2	2.55	1.35	.8	.8	.8	1.15	2.05
9	2.0	2.9	3.6	4.3	2.2	2.6	1.5	.75	.8	.8	1.2	3.05
10	1.95	2.8	3.8	4.9	2.2	2.4	1.4	.75	.8	.8	1.35	2.7
11	1.95	2.8	5.15	4.8	2.15	2.55	1.35	.75	.8	.8	1.6	2.7
12	1.85	2.85	4.9	4.75	2.1	2.4	1.3	.75	.8	.8	1.8	2.9
13	1.85	2.8	3.4	4.6	2.0	2.3	1.25	.75	.8	.85	2.1	3.05
14	2.0	2.7	4.9	3.6	2.0	2.3	1.2	.8	.8	.9	2.4	3.4
15	2.35	2.75	4.0	3.4	2.0	2.25	1.7	.8	.8	.9	3.3	2.8
16	2.3	2.7	3.6	3.9	2.1	2.2	1.4	.8	.8	.9	3.8	2.7
17	2.35	3.1	3.5	3.5	2.1	2.2	1.3	.75	.8	.9	4.1	2.7
18	2.3	3.2	3.5	3.4	2.05	2.1	1.2	.75	.8	.9	4.4	2.6
19	2.2	3.3	3.3	3.4	2.05	2.1	1.15	.7	.8	.9	3.05	2.6
20	1.95	5.05	3.6	3.4	2.05	2.05	1.15	.7	.8	.9	2.6	3.7
21	1.85	6.1	3.5	3.25	2.05	2.0	1.1	.7	.8	.9	2.5	6.1
22	2.0	6.35	2.95	3.1	2.0	2.0	1.05	.7	.8	.9	2.3	8.7
23	2.35	5.7	3.2	3.05	2.0	2.0	1.05	.7	.8	.9	2.2	9.8
24	3.15	5.65	3.25	3.0	1.9	1.95	1.05	.7	.8	.9	2.1	8.2
25	3.3	5.15	3.4	2.9	1.85	1.85	1.05	.7	.8	.9	2.0	7.1
26	3.7	5.0	3.6	3.4	1.8	1.6	1.05	.7	.8	.9	1.85	6.8
27	4.2	4.8	4.9	3.1	1.75	1.7	1.0	.7	.8	.95	1.6	7.0
28	4.05	4.75	5.4	3.0	1.7	1.6	1.0	.7	.8	.95	1.5	7.4
29	4.0	....	6.1	2.9	2.2	1.65	.95	.7	.8	.95	1.5	6.8
30	3.9	....	6.4	3.0	3.8	1.75	.95	.7	.8	.95	1.6	7.1
31	3.6	....	5.8	....	2.7	....	.95	.75	....	.9	....	7.6

Rating table for Palouse River at Hooper, Wash., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.60	10	1.70	110	2.80	331	3.90	670	6.00	1,965
0.70	13	1.80	125	2.90	355	4.00	715	6.20	2,120
0.80	17	1.90	141	3.00	380	4.20	805	6.40	2,280
0.90	22	2.00	158	3.10	405	4.40	900	6.60	2,440
1.00	28	2.10	176	3.20	430	4.60	1,015	6.80	2,620
1.10	36	2.20	195	3.30	457	4.80	1,135	7.00	2,800
1.20	46	2.30	215	3.40	486	5.00	1,265	8.00	3,780
1.30	57	2.40	236	3.50	517	5.20	1,400	9.00	4,900
1.40	69	2.50	259	3.60	551	5.40	1,540	10.00	6,200
1.50	82	2.60	283	3.70	588	5.60	1,680		
1.60	96	2.70	307	3.80	628	5.80	1,820		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1906 and is well defined between gage heights 0.8 feet and 10.0 feet.

Monthly discharge of Palouse River at Hooper, Wash., for 1906.

[Drainage area, 2,210 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	805	82	269	16,500	0.122	0.14
February	2,240	307	784	43,500	.355	.37
March	2,280	367	857	52,700	.388	.45
April	1,960	355	842	50,100	.381	.43
May	628	110	208	12,800	.094	.11
June	588	96	231	13,700	.105	.12
July	110	25	56.8	3,490	.026	.03
August	22	13	15.3	941	.0069	.01
September	17	17	17.0	1,010	.0077	.01
October	25	17	20.4	1,250	.0092	.01
November	900	22	196	11,700	.089	.10
December	5,920	82	1,360	83,600	.615	.71
The year	5,920	13	405	291,000	.183	2.49

NOTE.—Values are rated as good.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Snake River drainage basin in 1906:

Asotin Creek at Asotin, Wash.—This station, which was discontinued December 31, 1905, is described in Water-Supply Paper No. 178, page 167. A measurement was made December 21, 1906.

Width, 52 feet; area, 68 square feet; gage height, 3.97 feet; discharge, 290 second-feet.

Bear Creek near Wallowa, Oreg.—The reference point is on top of the lower end of the left floor beam; gage heights are distances below reference point.

May 22, width 35 feet; area, 55 square feet; gage height, −7.66 feet; discharge, 226 second-feet.

June 26, width, 37 feet; area, 62 square feet; gage height, −7.45 feet; discharge, 259 second-feet.

Five point Creek near Hilgard, Oreg.—A measurement was made just above the mouth March 10, 1906. The water surface was 6.34 feet below the top of the highway bridge floor, upstream side, at a point 23 feet from the right end of the floor.

Width, 25 feet; area, 45 square feet; discharge, 157 second-feet.

A measurement was made at low water December 4, 1906. The water surface was 7.15 feet below a bent spike in the downstream side of the top log of the right abutment of the highway bridge.

Width, 20 feet; area, 21 square feet; discharge, 7.4 second-feet.

Minam Creek near Lovely, Oreg.—The discharge of this stream was found December 9, 1906, by taking the difference of the discharges of Wallowa River above and below its mouth. Discharge, 228 second-feet.

Wallowa River near Lovely, Oreg.—A measurement was made at medium stage, December 9, 1906, at the footbridge just below Canyon stage stations and above the mouth of Minam Creek. The water surface was 1.08 feet below a small ledge of projecting rock on the right bank, 9.0 feet vertically underneath a point on the top of the downstream log of the footbridge, 7.5 feet from the right end of the log.

Width, 85 feet; area, 186 square feet; discharge, 549 second-feet.

Miscellaneous measurements in Snake River drainage basin in 1906.

Date.	Stream.	Locality.	Width.	Area of section.	Discharge.
			Feet.	*Sq. ft.*	*Sec.-ft.*
January 9	Boise River	Below Barber dam and 7 miles above Boise, Idaho.	144	261	562
April 4	Burnt River	Huntington, Oreg.	78	156	696
August 6	Cedar Creek	In canyon, 8 miles above Mackay, Idaho.	10	6.2	12.5
July 19	North Fork Buffalo River	At most northerly meadows, Wyoming.	62	75	165
September 8	John Day River	Junction with South Fork Snake River, Wyoming.	42	104	592

WALLA WALLA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Walla Walla River heads on the northwestern slope of the Blue Mountains in northeastern Oregon and southeastern Washington, flows westward, and unites with the Columbia at Wallula, Wash. The Blue Mountains have an elevation of approximately 2,000 feet above the surrounding country; their northwestern slope is drained by the numerous tributaries of the Walla Walla and their southeastern slope by those of Grande Ronde River, a tributary of the Snake. The drainage basin is a broad, triangular-shaped area, aggregating 1,050 square miles. Except on the mountain slopes the area is timberless, being composed of rolling table-lands devoted largely to the production of wheat. The valleys are level tracts in which irrigation has reached a high stage of development. The rainfall at Walla Walla, Wash., is about 18 inches per annum. The principal tributaries of the stream are Little Walla Walla River, Mill Creek, on which the city of Walla Walla is situated, Garrison Creek, Yellowhawk Creek, Cottonwood Creek, and South Fork of Walla Walla River.

The main stream and its tributaries are used extensively for irrigation and power. The power plant of the Northwestern Gas and Electric Company, from which the cities of Pendleton, Walla Walla, Weston, and neighboring towns are connected by an electric line, is located on South Fork of Walla Walla River, about 12 miles above Milton.

WALLA WALLA RIVER NEAR MILTON, OREG.

This station was established August 12, 1905, to replace the station at Milton, Oreg., one-half mile below. It was located near the old city reservoir, 1½ miles above Milton, but the gage, cable, and bench mark were destroyed by flood May 30, 1906, and on August 16, 1906, the station was reestablished at West's highway bridge, 3 miles above Milton. A small ditch heads just above the bridge.

The channel is straight above the station and curved below. The water is shallow and the current swift. The banks are low and liable to overflow. The bed of the stream is composed of clean sand and gravel and liable to shift. There is one channel at all stages.

Measurements are made from the bridge. The initial point is the face of the right abutment.

The gage, which is read by Maud Osborn, is a 2 by 6 inch timber spiked vertically to the right abutment. The bench mark is a 20-penny spike in pole 1170 of a transmission line at the southwest corner of the bridge; elevation, 9.03 feet above the datum of the gage.

The conditions at the old station and the bench marks are described in Water-Supply Paper No. 178, page 178, where are given also references to publications that contain data for previous years.

Discharge measurements of Walla Walla River near Milton, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 19	R. S. Hall	60	91	[a] 4.62	413
March 23	Cupper and Buchanan	47	60	[a] 4.11	181
May 22	P. A. Cupper	45	66	[a] 4.13	187
June 28 [b]	do	45	59		186
July 21 [b]	do	44	56		112
August 4 [b]	do	43	50		99
August 29	do	43	52	[c] 1.63	97
December 11	H. McGlashan	63	72	[c] 2.20	300

[a] Gage near city reservoir.

[b] Measured by wading at mouthof Couse Creek.

[c] Gage at West's bridge.

Daily gage height, in feet, of Walla Walla River near Milton, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Sept.	Oct.	Nov.	Dec.
1	4.02	4.28	4.38	4.70	4.45	[a] 1.35	1.65	1.75	1.95
2	4.00	4.28	4.32	4.00	4.45	1.55	1.75	1.75	1.95
3	4.00	4.20	4.28	4.60	4.48	1.45	1.75	1.65	1.85
4	4.02	4.20	4.28	4.60	4.45	1.65	1.65	1.70	1.85
5	4.10	4.18	4.22	4.60	4.35	1.65	1.85	1.75	1.90
6	4.22	4.15	4.22	4.62	4.35	1.55	1.75	1.75	1.95
7	4.32	4.10	4.25	4.62	4.30	1.35	1.75	1.85	2.05
8	4.30	4.10	4.30	4.65	4.30	1.65	1.65	1.85	2.05
9	4.22	4.08	4.38	4.70	4.30	1.55	1.75	1.90	2.15
10	4.20	4.08	4.38	4.60	4.30	1.65	1.75	1.95	2.05
11	4.20	4.08	4.35	4.55	4.30	1.55	1.75	2.65	2.05
12	4.18	4.05	4.32	4.45	4.30	1.55	1.65	2.85	2.35
13	4.22	4.02	4.25	4.42	4.25	1.65	1.75	2.75	2.30
14	4.22	4.02	4.22	4.48	4.25	1.75	1.75	2.95	2.20
15	4.20	4.05	4.22	4.50	4.28	1.75	1.75	3.25	2.15

Daily gage height, in feet, of Walla Walla River near Milton, Oreg., in 1906—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Sept.	Oct.	Nov.	Dec.
16	4.28	4.05	4.20	4.58	4.22	1.75	1.85	3.65	2.30
17	4.22	4.05	4.15	4.55	4.15	1.75	1.75	2.95	2.20
18	4.20	4.20	4.12	4.52	4.25	1.75	1.75	2.75	2.25
19	4.18	4.60	4.10	4.52	4.25	1.65	1.75	2.65	2.35
20	4.12	4.60	4.10	4.52	4.12	1.75	1.75	2.55	2.15
21	4.10	4.60	4.10	4.62	4.13	1.75	1.65	2.35	4.00
22	4.12	4.55	4.10	4.70	4.12	1.75	1.75	2.15	3.40
23	4.18	4.45	4.10	4.65	4.13	1.85	1.75	2.05	3.00
24	4.40	4.42	4.25	4.60	4.12	1.85	1.70	1.95	2.95
25	4.50	4.38	4.30	4.52	4.10	1.75	1.75	1.95	2.96
26	4.45	4.35	4.32	4.48	4.12	1.75	1.75	1.95	2.90
27	4.40	4.40	4.62	4.45	4.13	1.75	1.65	1.90	2.85
28	4.32	4.40	4.62	4.45	4.12	1.85	1.75	1.85	2.65
29	4.30	....	4.58	4.45	5.90	1.75	1.70	1.80	2.80
30	4.28	....	4.60	4.45	(b)	1.65	1.75	1.85	2.75
31	4.25	....	4.72	....	....	....	1.75	....	2.75

[a] On gage at West's bridge.

[b] Gage and cable washed away by flood.

Rating table for Walla Walla River near Milton, Oreg., from January 1 to May 29, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.80	94	4.10	175	4.30	251	4.50	349	4.70	469
3.90	117	4.20	210	4.40	297	4.60	406	4.80	534
4.00	144								

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined below gage height 4.2 feet.

Monthly discharge of Walla Walla River near Milton, Oreg., for 1906.

[Drainage area, 130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	349	144	221	13,600	1.70	1.96
February	406	150	239	13,300	1.84	1.92
March	482	175	260	16,000	2.00	2.31
April	469	307	384	22,800	2.95	3.29
May 1-29	1,370	175	274	15,800	2.11	2.28
The period	....	....	....	81,500	....	....

NOTE.—Values are rated as excellent.

SOUTH FORK OF WALLA WALLA RIVER NEAR MILTON, OREG.

This station was originally established February 15, 1903, 6 miles above the mouth of the river and 12 miles from Milton, Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 176, where are given also references to publications that contain data for previous years.

The flood of May 30, 1906, entirely changed the channel. On August 10, 1906, a new station was established one-fourth mile above the headgate of the Northwestern Gas and Electric Company's pipe line. This point is above all diversions.

The channel is straight for 200 feet above and below the station. The banks are low and liable to overflow. There is one channel at all stages. The bed of the stream is of gravel and will change during high floods. The current is swift at all stages.

Measurements are made by wading 17 feet below the gage. The initial point for soundings is a blaze on a cottonwood tree on the left bank.

Gage heights are furnished by the Northwestern Gas and Electric Company, through Mr. Paul Young. The gage is a 2 by 6 inch timber, spiked in a vertical position to a tree on the left bank. The bench mark is a spike in the roots of a large cottonwood tree on the left bank, 10 feet from the gage; elevation, 7.74 feet above the datum of the gage.

Discharge measurements of South Fork of Walla Walla River near Milton, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 20	R. S. Hall	48	71	[a] 2.10	390
March 23	P. A. Cupper	45	41	[a] 1.50	159
May 24	do	45	48	[a] 1.66	171
August 10	J. C. Stevens	45	49	[b] 2.50	120
December 13	H. McGlashan	42	56	[b] 3.73	183

[a] Gage at bridge.

[b] Gage at headgate.

Daily gage height, in feet, of South Fork of Walla Walla River near Milton, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Aug.	Sept.
1	....	1.7	1.7	2.0	2.0	1.2	....	2.5
2	1.55	1.7	1.65	2.0	2.0	....	....	2.5
3	1.55	....	1.65	2.0	....	1.0	....	2.5
4	....	1.65	1.65	2.0	2.0	....	....	2.5
5	1.6	1.6	1.6	2.0	1.95	....	....	2.5
6	1.7	1.6	1.6	2.0	1.9	....	....	2.5
7	....	1.6	1.6	2.1	1.85	....	....	2.5
8	1.65	1.6	1.7	2.1	1.8	....	....	2.5
9	1.65	1.6	....	2.1	1.85	....	....	2.52
10	1.7	....	1.7	2.0	....	....	2.5	2.52
11	1.65	1.55	....	....	1.9	....	2.5	2.51
12	....	1.55	....	1.8	1.9	....	2.53	2.5
13	1.65	1.55	....	1.8	1.86	....	2.55	2.55
14	1.65	1.55	....	1.8	1.85	....	2.52	2.56
15	1.65	1.55	1.5	1.9	1.8	....	2.52	2.55
16	1.7	1.55	....	1.9	....	....	2.51	....
17	1.7	....	....	1.9	1.75	....	2.51	....
18	1.7	....	1.5	1.9	1.7	....	2.52	....
19	1.7	2.2	1.5	1.9	1.7	....	2.5	....
20	....	2.0	1.5	1.95	1.7	....	2.5	....
21	1.65	2.1	1.5	2.0	....	....	2.5	....
22	1.65	2.0	....	2.2	1.7	....	2.57	....
23	1.8	1.9	1.5	2.2	1.7	....	2.55	....
24	1.8	1.8	1.6	2.1	....	....	2.53	....
25	1.95	1.8	1.7	2.05	....	....	2.52	....
26	1.9	1.8	2.0	2.0	1.7	....	2.52	
27	1.8	1.75	2.0	1.95	1.7	....	2.52	....
28	1.75	1.75	2.0	1.9	1.7	....	2.5	....
29	1.7	....	2.0	1.95	2.86	....	2.5	....
30	1.7	....	1.95	2.0	....	....	2.5	....
31	1.7	....	2.15	....	....	....	2.5	....

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Walla Walla River drainage basin during 1906:

Couse Creek near Milton, Oreg.—March 23, discharge, 10 second-feet; August 10, dry.

Dry Creek near Milton, Oreg.—A measurement was made 500 feet below the crossing of Finis Irrigation Company's flume. The water surface was 0.5 foot below the bench mark on a rock 50 feet above the section.

Width, 18 feet; area, 10 square feet; discharge, 13 second-feet.

Walla Walla River at Milton, Oreg.—The following discharges were computed from slope measurements for the spring and fall floods:

May 30, width, 816 feet; area, 924 square feet; discharge, 8,130 second-feet.
November 14, width, 281 feet; area, 632 square feet; discharge, 4,550 second-feet.

North Fork of Walla Walla River near Milton, Oreg.—Measurements were made near the junction with South Fork.

March 23, width, 17 feet; area, 12 square feet; discharge, 28 second-feet.
March 24, width, 16 feet; area, 8 square feet; discharge, 21 second-feet.
August 29, width, 12 feet; area, 12 square feet; discharge, 7 second-feet.

UMATILLA RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Umatilla River rises in the western slopes of the Blue Mountains in northeastern Oregon, flows westward, and joins Columbia River at the town of Umatilla. Its drainage area is timberless except on the mountain slopes, and is composed of rolling table-lands devoted largely to the production of wheat. The rainfall on the drainage area varies from 24 inches on the headwaters to 10 inches at the mouth.

The waters of this stream are used for both power and irrigation purposes, and it is one of the most important rivers in the State..

UMATILLA RIVER AT GIBBON, OREG.

This station was established July 22, 1896. It is located about 1 mile west of Bingham Springs Railroad station (Gibbon post-office), Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 181, where are given also references to publications that contain data for previous years.

The gage at this station was read during a portion of 1906 by J. C. Hilliard. The gage was washed out May 30, 1906, and on December 3 a new one was installed about 50 feet upstream from the cable on the left bank. It consists of a 2 by 6 inch timbers, in two sections, spiked to cottonwood trees. The bench mark is a spike in the root of a 16-inch yellow pine, 415 feet from the initial point for soundings, 160 feet from the railroad track, and 20 feet upstream from the line of the cable extended; elevation, 9.03 feet above the datum of the gage.

Discharge measurements of Umatilla River at Gibbon, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 1	R. S. Hall	53	67	[a]1.80	351
March 14	do	55	80	[a]1.85	415
April 2	do	117	260	[a]3.28	1,680
April 21	J. C. Stevens	112	203	[a]2.80	1,310
May 26	R. S. Hall	44	44	[a]1.40	203
June 6	do	112	307		1,390
July 9	do	86	80		102
December 3	Stevens and McGlashan	102	132	[b]1.50	183

[a] Old gage. [b] New gage.

Daily gage height, in feet, of Umatilla River at Gibbon, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	Dec.	Day.	Jan.	Feb.	Mar.	Apr.	May.	Dec.
1	1.45		1.9	3.7	2.2		17	1.6		1.7	2.4	1.5	1.9
2	1.4	1.8	1.9	3.25			18	1.6	1.7	1.7	2.4	1.45	1.9
3	1.4	1.8	1.8	2.9	2.0	[a]1.5	19	1.55	2.4		2.4	1.4	1.9
4	1.5	1.8	1.8	2.9	2.0	1.5	20	1.55	2.3	1.5	2.7	1.4	5.2
5	1.5	1.8	1.8	2.8	2.0	1.5	21	1.5	2.4	1.5	2.8	1.4	5.8
6		1.7	1.8	2.9	1.95	1.6	22	1.5	2.3	1.5	2.9	1.4	4.5
7	1.8	1.6	1.8	3.3	1.9	2.1	23		2.2	1.5		1.4	3.8
8	1.7	1.6	2.05		1.8	2.5	24	2.0	2.0	2.0	2.5	1.4	3.6
9	1.65	1.6	2.3		1.8	2.4	25	2.25	2.0	2.7	2.5	1.4	3.7
10	1.65	1.55	2.4	2.9	1.75	2.2	26	2.1	2.0	2.75	2.5	1.4	4.1
11	1.6	1.5		2.8	1.75	2.2	27	2.0		3.4	2.4	1.4	3.7
12	1.7	1.5	2.0	2.5	1.7	2.2	28	1.95		3.3	2.4	1.7	3.6
13	1.65	1.5	1.9	2.5	1.7	2.1	29	1.9		3.0	2.4		3.4
14	1.6	1.5		2.4	1.7	2.0	30	1.9		3.5	2.3	([b])	3.1
15	1.6	1.5		2.5	1.6	2.0	31	1.85		4.1			3.0
16	1.6	1.5	1.7	2.4	1.5	1.9							

[a] New gage installed December 3. No relation determined for the two gages.
[b] Gage destroyed by flood.

Rating table for Umatilla River at Gibbon, Oreg., from January 1 to May 29, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	190	2.00	555	2.60	1,075	3.20	1,660	3.80	2,305
1.50	233	2.10	635	2.70	1,170	3.30	1,765	3.90	2,415
1.60	284	2.20	720	2.80	1,265	3.40	1,870	4.00	2,530
1.70	343	2.30	805	2.90	1,360	3.50	1,975	4.10	2,645
1.80	408	2.40	895	3.00	1,460	3.60	2,085		
1.90	479	2.50	985	3.10	1,560	3.70	2,195		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and is well defined below gage heights 3.0 feet.

Monthly discharge of Umatilla River at Gibbon, Oreg., for 1906.

[Drainage area, 353 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	762	190	352	21,600	1.00	1.15
February	895	233	441	24,500	1.25	1.30
March	2,640	233	734	45,100	2.08	2.40
April	2,200	805	1,190	70,800	3.37	3.76
May 1-28	720	190	344	19,100	.975	1.02
The period				181,000		

NOTE.—Values January to May are rated as good.

UMATILLA RIVER AT YOAKUM, OREG.

This station was established May 5, 1903. It is located one-half mile east of Yoakum, a station of the Oregon Railroad and Navigation Company, at what is known as the Yoakum wagon bridge. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 185, where are given also references to publications that contain data for previous years.

Discharge measurements of Umatilla River at Yoakum, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 19	R. S. Hall	75	224	4.45	516
April 20	J. C. Stevens	76	352	5.98	1,570
June 2	R. S. Hall	......	531	8.30	4,780
July 11	.....do	74	154	3.20	93
November 26[a]	H. McGlashan	76	229	4.05	284

[a] Some slack water and eddies.

Daily gage height, in feet, of Umatilla River at Yoakum, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.3	5.3	5.3	8.05	5.0	9.5	3.7	2.7	2.8	2.9	3.2	3.9
2	4.3	5.1	5.3	7.25	5.0	8.0	3.6	2.7	2.8	2.9	3.2	3.9
3	4.1	5.0	5.2	7.0	4.9	7.4	3.5	2.7	2.8	3.0	3.2	3.9
4	4.1	4.8	5.2	7.1	4.9	7.4	3.5	2.7	2.8	3.0	3.1	3.9
5	4.1	4.6	5.1	7.2	4.7	7.3	3.4	2.7	2.8	3.0	3.2	3.9
6	4.2	4.5	5.0	7.2	4.7	7.2	3.3	2.7	2.8	3.0	3.2	4.0
7	4.6	4.5	4.9	7.2	4.5	6.9	3.3	2.7	2.8	3.0	3.2	4.3
8	4.6	4.4	5.1	7.2	4.4	6.7	3.2	2.7	2.8	3.0	3.3	4.6
9	4.04	4.4	5.5	7.3	4.4	6.5	3.1	2.7	2.8	3.0	3.5	4.8
10	4.2	4.3	5.7	6.8	4.3	6.2	3.1	2.7	2.8	3.0	3.5	4.8
11	4.3	4.3	5.8	6.5	4.3	5.7	3.1	2.7	2.8	3.0	3.5	4.8
12	4.3	4.2	5.5	6.1	4.2	5.4	3.1	2.8	2.8	3.0	3.5	4.7
13	4.3	4.1	5.5	6.0	4.2	5.0	3.1	3.0	3.0	3.0	3.5	4.6
14	4.3	4.1	5.2	6.0	4.2	4.9	3.1	3.0	3.1	3.0	5.2	4.5
15	4.2	4.0	5.1	6.1	4.2	4.8	3.0	3.0	3.1	3.0	5.9	4.5
16	4.2	4.0	5.0	6.4	4.2	4.8	3.0	3.0	3.1	3.5	5.7	4.5
17	4.3	4.0	4.9	6.3	4.0	4.6	3.0	3.0	3.0	3.5	5.0	4.4
18	4.3	4.0	4.5	6.1	4.0	4.5	3.0	2.9	3.0	3.5	4.9	4.4
19	4.3	5.0	4.6	6.0	3.9	4.5	3.0	2.9	3.0	3.5	4.5	4.5
20	4.3	5.8	4.6	6.0	3.9	4.4	2.9	2.8	3.0	3.5	4.5	6.8
21	4.2	5.7	4.6	6.2	3.9	4.3	2.9	2.8	3.0	3.5	4.5	9.0
22	4.2	5.7	4.7	6.4	3.9	4.3	2.9	2.8	3.0	3.5	4.4	7.8
23	4.3	5.6	4.7	6.3	3.9	4.2	2.8	2.8	2.9	3.6	4.3	7.0
24	4.8	5.6	5.9	5.9	3.9	4.2	2.8	2.8	2.9	3.6	4.3	6.5
25	5.3	5.5	6.1	5.7	3.9	4.1	2.8	3.0	2.9	3.6	4.2	6.5
26	5.8	5.4	6.7	5.45	3.9	4.0	2.7	2.9	2.9	3.6	4.0	7.0
27	5.7	5.3	7.2	5.3	3.8	4.0	2.7	2.9	2.9	3.6	4.0	7.1
28	5.6	5.3	7.4	5.3	4.0	4.1	2.7	2.8	2.9	3.5	4.0	6.5
29	5.4	....	7.0	5.2	6.65	3.9	2.7	2.8	2.9	3.4	4.0	6.4
30	5.4	....	7.2	5.2	[a]15.0	3.8	2.7	2.8	2.9	3.3	4.0	6.4
31	5.3	....	7.75	....	13.0	....	2.7	2.8	....	3.3	....	6.4

[a] Estimated; water overflowed bottom lands.

Rating table for Umatilla River at Yoakum, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.70	28	3.80	225	4.90	755	6.00	1,645	8.20	4,590
2.80	37	3.90	253	5.00	820	6.20	1,840	8.40	4,940
2.90	47	4.00	284	5.10	890	6.40	2,040	8.60	5,300
3.00	59	4.10	320	5.20	965	6.60	2,260	8.80	5,680
3.10	73	4.20	360	5.30	1,040	6.80	2,500	9.00	6,060
3.20	89	4.30	410	5.40	1,120	7.00	2,750	10.00	8,190
3.30	107	4.40	460	5.50	1,200	7.20	3,020	11.00	10,750
3.40	127	4.50	515	5.60	1,285	7.40	3,310	12.00	13,730
3.50	149	4.60	570	5.70	1,370	7.60	3,610	13.00	17,000
3.60	173	4.70	630	5.80	1,460	7.80	3,930	14.00	20,400
3.70	199	4.80	690	5.90	1,550	8.00	4,250	15.00	23,900

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903-1906 and is well defined below gage height 9.7 feet.

Monthly discharge of Umatilla River at Yoakum, Oreg., for 1906.

[Drainage area, 1,200 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,460	298	587	36,100	0.489	0.56
February	1,460	284	607	38,700	.581	.60
March	3,850	515	1,370	84,200	1.14	1.31
April	4,340	965	2,090	124,000	1.74	1.94
May	23,900	225	1,770	109,000	1.47	1.70
June	7,080	225	1,460	86,900	1.22	1.36
July	199	28	72.7	4,470	.061	.07
August	59	28	39.4	2,420	.033	.04
September	73	37	48.4	2,880	.040	.04
October	173	47	105	6,460	.088	.10
November	1,550	73	384	22,800	.320	0.36
December	6,060	253	1,360	83,600	1.13	1.30
The year	23,900	28	832	602,000	.693	9.38

NOTE.—Values are rated as follows: January, February, and July to November, good; March to June and December, excellent.

UMATILLA RIVER AT UMATILLA, OREG.

This station was established October 21, 1903. It is located about 1 mile above Umatilla, Oreg., and about one-fourth mile below the diversion dam of the Oregon Land and Water Company. To obtain the total discharge of the river, the discharge of the irrigation ditch must be added to that of the river at the gage. The gage was read during 1906 by N. E. Newton. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 188, where are given also references to publications that contain data for previous years.

Discharge measurements of Umatilla River at Umatilla, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 20	R. S. Hall	167	165	3.08	383
1906.					
February 22	R. S. Hall	177	328	4.00	1,330
March 17	do	174	219	3.40	652
April 19	J. C. Stevens	176	328	4.05	1,440
May 28	R. S. Hall	154	105	2.70	169
May 31[a]	Stevens and Lewis	......	1,620	11.00	17,500
June 11	R. S. Hall	176	330	4.05	1,360
June 23	do	165	178	3.02	414
August 11[b]	J. C. Stevens	......	......	1.10	0.3
November 25	H. McGlashan	165	163	3.00	348

[a] Measured by floats.

[b] Stream bed dry except at left edge.

Daily gage height, in feet, of Umatilla River at Umatilla, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	......	......	5.4	3.5	8.0	2.65	1.0	1.2	1.8	2.3	2.8
2	......	3.4	3.8	......	......	6.3	......	......	......	2.1	2.3	......
3	2.8	......	......	4.9	3.4	5.5	2.5	1.0	1.2	2.15	2.25	2.75
4	......	3.35	3.6	......	......	......	......	......	......	2.1	2.3	......
5	2.8	......	......	4.7	3.3	5.4	2.25	1.0	1.2	2.0	2.3	2.7
6	......	3.3	3.5	......	......	......	......	......	......	2.0	2.35	......
7	3.0	......	......	4.7	3.15	5.0	2.0	1.0	1.2	2.1	2.4	2.7
8	......	3.25	3.4	......	......	......	......	......	......	2.1	2.4	......
9	3.25	......	......	4.8	3.05	4.5	1.75	1.0	1.2	2.1	2.4	3.1
10	......	3.2	3.7	......	......	......	......	......	......	2.1	2.6	......
11	3.2	......	......	4.6	2.9	4.1	1.7	1.1	1.2	2.1	2.6	3.2
12	......	3.0	3.7	......	......	......	......	......	......	2.1	2.6	......
13	3.1	......	......	4.2	2.85	3.8	1.6	1.1	1.25	2.1	2.6	3.3
14	......	2.95	3.9	......	......	......	......	......	......	2.2	2.6	......
15	3.1	......	......	4.0	2.9	3.5	1.3	1.1	1.3	2.2	3.9	3.3
16	......	2.9	3.6	......	......	3.7	......	......	......	2.15	3.8	......
17	3.1	......	......	4.2	2.85	3.6	1.2	1.1	1.8	2.2	3.7	3.2
18	......	3.0	3.3	......	......	......	......	......	......	2.2	3.6	3.15
19	3.0	......	......	4.1	2.7	3.3	1.1	1.1	1.9	2.2	3.4	3.1
20	......	3.5	3.2	......	......	......	......	......	......	2.3	3.3	3.0
21	3.0	......	......	4.0	2.65	3.15	1.1	1.1	1.85	2.3	3.2	5.2
22	......	4.1	3.2	......	......	......	......	......	......	2.25	3.1	6.1
23	3.0	......	......	4.1	2.7	3.0	1.1	1.1	1.85	2.25	3.1	5.2
24	......	3.9	3.2	......	......	......	......	......	......	2.3	3.0	4.7
25	3.6	......	......	3.9	2.6	2.9	1.0	1.2	1.85	2.3	3.0	4.5
26	......	3.8	4.2	......	......	......	......	......	......	2.3	2.95	4.6
27	3.85	......	......	3.7	2.6	2.7	1.1	1.2	1.8	2.3	2.9	4.9
28	......	3.7	4.8	......	2.7	......	......	......	......	2.3	2.9	4.65
29	3.6		......	3.6	2.8	2.8	1.1	1.2	1.8	2.35	2.9	4.45
30	......		4.7	......	6.85	......	......	......	......	2.4	2.85	4.3
31	3.5		......		10.2		1.1	1.2		2.35		4.3

Rating table for Umatilla River at Umatilla, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.10	0.1	2.10	21	3.10	400	4.20	1,670	6.20	5,220
1.20	.2	2.20	32	3.20	485	4.40	1,975	6.40	5,620
1.30	.3	2.30	45	3.30	575	4.60	2,290	6.60	6,030
1.40	.4	2.40	60	3.40	675	4.80	2,620	6.80	6,450
1.50	.5	2.50	80	3.50	775	5.00	2,960	7.00	6,880
1.60	.7	2.60	108	3.60	885	5.20	3,310	8.00	9,200
1.70	1.5	2.70	146	3.70	1,000	5.40	3,675	9.00	11,800
1.80	3.5	2.80	194	3.80	1,125	5.60	4,050	10.00	14,580
1.90	7.5	2.90	252	3.90	1,250	5.80	4,435	11.00	17,500
2.00	13	3.00	320	4.00	1,385	6.00	4,825		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1903–1906 and is well defined between gage heights 2 feet and 7 feet.

Monthly discharge of Umatilla River at Umatilla, Oreg., for 1906.

[Drainage area, 2,130 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,190	194	492	30,300	0.231	0.27
February	1,520	252	691	38,400	.324	.34
March	3,070	485	1,130	69,500	.531	.61
April	3,680	830	1,860	111,000	.873	.97
May	15,200	108	983	60,400	.462	.53
June	9,200	146	1,690	101,000	.793	.88
July	127	0	15.0	922	.007	.01
August	0.2	0	.094	5.8	.000044	.00005
September	7.5	0.2	2.46	146	.0012	.001
October	60	3.5	31.9	1,960	.015	.02
November	1,250	38.5	323	19,200	.152	.17
December	5,020	146	1,180	72,600	.554	.64
The year	15,200	0	700	505,000	.329	4.45

NOTE.—Values are rated as follows: January to June, November and December, excellent; July and October, fair; August and September, approximate. Discharges interpolated for days on which gage heights were not observed.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Umatilla River drainage basin during 1906:

Meacham Creek at Gibbon, Oreg.—A measurement was made from the highway bridge one-half mile east of the Bingham Springs railroad station February 1, 1906. The water surface was 8.72 feet below the lower end of the floor plank, 5.3 feet from the left end of the truss.

Width, 45 feet; area, 130 square feet; discharge, 189 second-feet.

Minnehaha Spring near Hermiston, Oreg.—The following measurement was made May 7, 1906:

Width, 6 feet; area, 2.7 feet; discharge, 2.6 second-feet.

Wild Horse Creek near Pendleton, Oreg.—A measurement was made February 26, 1906. The water surface was 7.42 feet below a tack in the upstream side of the bridge.

Width, 16 feet; area, 13 square feet; discharge, 22 second-feet.

Discharge measurements of Umatilla River near Fosters,[a] Oreg., in 1905–6.

Date.	Width.	Area of section.	Gage height.	Discharge.
1905.	*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 11	66	55	1.08	40
December 4	82	106	1.78	227
December 22	115	159	2,10	413
December 28	102	124	1.84	291
1906.				
January 5	100	115	1.80	219
January 13	116	157	2.18	420
January 17	116	166	2.18	429
January 29	138	267	2.90	1,090
February 9	117	161	2.12	423
February 17	105	129	1.85	284
March 2	138	272	2.95	1,140

[a] At highway bridge, 4 miles below Echo, Oreg.

Discharge measurements of Umatilla River at Pendleton, Oreg., in 1906.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 31 [a]	89	297	....	582
February 3 [b]	104	144	4.48	540
February 14 [a]	82	246	4.20	253
February 26 [b]	115	196	4.78	903
March 21 [a]	85	254	4.28	317

[a] From Oregon Railroad and Navigation Company's railway bridge.
[b] From highway bridge.

CANALS IN UMATILLA RIVER VALLEY, OREGON.

The points of diversion of these canals and the points of measurement are described in Water-Supply Paper No. 178, pages 190 to 201, where are also given the data collected during 1905.

Discharge measurements of canals in Umatilla River Valley, Oregon, in 1906.

HORSESHOE IRRIGATION COMPANY'S CANAL, YOAKUM.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
March 3	4	2	....	2.5
May 4	3.4	1.4	....	.87

SLUSHER AND GOULD CANAL, NOLIN.

Date.	Width.	Area of section.	Gage height.	Discharge.
January 6	4.2	3.5	0.77	2.0
March 3	4.1	1.6	.42	.9

CHARLES LISLE CANAL, ECHO.

Date.	Width.	Area of section.	Gage height.	Discharge.
January 6	7.6	6.9	0.99	1.9
January 17	7.7	7.0	.94	1.8
February 8	7.3	5.8	.82	1.8
February 17	9.8	9.2	1.24	.94
May 4	8.2	6.9	.98	3.85

MILL CANAL, ECHO.

Date.	Width.	Area of section.	Gage height.	Discharge.
January 6	9.4	7.1	1.58	5.2
January 13	9.7	7.9	1.67	6.6
January 17	9.8	8.0	1.58	7.0
February 8	5.9	1.7	.89	.58
February 17	7.3	4.6	1.40	4.0
March 3	8.0	7.2	1.82	7.8
May 4	5.5	1.9	.99	1.3

MILL CANAL WASTEWAY, ECHO.

Date.	Width.	Area of section.	Gage height.	Discharge.
1905.				
December 28	7.0	5.2	1.10	3.8
1906.				
January 6	7.0	5.8	1.13	4.3
January 17	7.2	7.0	1.20	5.0
February 8	4.8	1.4	.34	0.18
February 17	6.7	5.02	.92	4.86
March 2	7.2	7.4	1.20	7.5

Discharge measurements of canals in Umatilla River Valley, Oregon, in 1906—Cont'd.

WILSON & CO.'S CANAL, ECHO.

Date.	Width.	Area of section.	Gage height.	Discharge.
	Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 8	7.6	4.6	2.72	4.2
May 4	7.1	3.2	1.58	2.6

ALLEN CANAL, ECHO.

1905.				
December 28	10.2	16	1.24	14
1906.				
January 5	10.2	16	1.25	13
January 17	10.3	16	1.25	12
March 2	9.7	6.9	....	2.8
May 5	10.7	17	1.15	29

ALLEN CANAL WASTEWAY, ECHO.

January 5	5.2	4.7	0.75	7.3
January 17 [a]	5.5	6.0	....	10
February 9	5.2	3.7	.52	3.14
February 17	3.6	2.2	.30	.47
March 2	3.5	2.4	.28	.44
May 5	3.6	2.5	.29	.7

HINKLE CANAL, ECHO.

January 5	14	14	1.70	14
January 13	13.8	14	1.70	15
January 17	14.4	14	1.71	15
February 8	15	16	1.91	20
February 17	12	11	1.50	9.3
March 2	12.7	13	1.73	14
May 5	16	25	2.43	42

PIONEER CANAL, ECHO.

January 5	8.2	3.4	0.80	2.2
January 17	9.7	5.1	.98	4.33
May 5	12.4	23	1.58	54

HERMISTON CANAL, HERMISTON.

1905.				
December 28	15.3	14	....	11
1906.				
January 15 [b]	15.4	15	....	11
February 16 [c]	16.0	17	0.62	17
May 7	19.0	29	1.34	39

BEITLE CANAL, HERMISTON.

May 7	3.7	1.8	0.92	1.4

OREGON LAND AND WATER COMPANYS CANAL, UMATILLA.

May 7	13.5	19	....	44
November 25	4.8	4.1	....	13

[a] Measured above wasteway.

[b] At headgate.

[c] Below headgate.

Discharge measurements of canals in Umatilla River Valley, Oregon, in 1906—Cont'd.

BROWNELL CANAL, HERMISTON.

Date.	Width.	Area of section.	Gage height.	Discharge.
1905.	*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 29	5	2.8	0.98	0.97
1906.				
January 15	5	4.3	1.72	4.0
May 7	5	6.4	1.58	10

MAXWELL CANAL, ECHO.

Date.	Width.	Area of section.	Gage height.	Discharge.
January 5	5.2	1.6	0.31	0.75
January 15	5.4	2.0	.30	1.0
May 3	10.4	8.4		15

WILLOW CREEK DRAINAGE BASIN.

DESCRIPTION OF BASIN.

This stream rises in the timbered foothills of the Blue Mountains and flows northwestward into Columbia River near Arlington. Its drainage area throughout is timberless, and is composed of high, rolling table-lands used for the production of wheat and as range for cattle and sheep. The creek is small but is subject to excessive and sudden floods. In 1903 this stream was the scene of the disaster at Heppner, where over one hundred lives were lost from a sudden flood lasting scarcely more than an hour. The waters of this stream are used to some extent for irrigation in the immediate valley.

WILLOW CREEK NEAR ARLINGTON, OREG.

This station was established December 17, 1904, and was abandoned July 21, 1906, on account of poor conditions. It is located at the wagon bridge at Rhea siding, 9 miles from Arlington, Oreg. The station was maintained as a flood station and miscellaneous measurements only are made during the summer season.

During 1906 the gage was read by G. R. Huff. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 202.

Discharge measurements of Willow Creek near Arlington, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 7	F. C. Dillard	24	85	([a])	33
February 28	R. S. Hall	23.5	51	1.50	55
March 31	F. C. Dillard	26	107	([a])	207
April 19	J. C. Stevens	23.5	41	1.12	32
June 9	R. S. Hall	24.5	89	3.15	306
June 9	do	24	94	3.40	353

[a] Gage not read.

Daily gage height, in feet, of Willow Creek near Arlington, Oreg., for 1906.

Day.	Mar.	Apr.	May.	June.	July.	Day.	Mar.	Apr.	May.	June.	July.
1	1.52	2.8	0.85	4.4	1.15	17	1.35	1.25	0.45	2.4	0.8
2	1.52	2.7	.8	3.9	1.1	18	1.6	1.2	.45	2.2	.8
3	1.5	2.5	.75	3.65	1.0	19	1.5	1.15	.45	2.0	.8
4	1.52	2.4	.65	3.9	.95	20	1.45	1.1	.45	1.9	.8
5	1.55	2.3	.6	4.05	.95	21	1.4	1.1	.45	1.8	.8
6	1.5	2.2	.6	3.75	.95	22	1.98	1.1	.45	1.6	......
7	1.52	2.1	.6	3.5	.95	23	2.45	1.1	.45	1.5	......
8	1.62	2.0	.6	3.2	.9	24	2.3	1.1	.45	1.4	......
9	1.75	1.9	.55	3.0	.85	25	2.4	1.1	.5	1.35	......
10	1.8	1.8	.5	3.1	.85	26	4.15	1.1	.5	1.25	......
11	1.8	1.7	.5	2.8	.9	27	3.0	1.0	.6	1.2	......
12	1.75	1.6	.45	2.6	.9	28	3.1	1.0	.55	1.2	......
13	1.8	1.5	.45	2.6	.9	29	2.7	.9	.5	1.2	......
14	1.8	1.4	.45	2.45	.85	30	2.4	.9	6.7	1.15	......
15	1.75	1.35	.4	2.3	.8	31	2.4	......	6.0	......	......
16	1.35	1.3	.45	3.1	.8						

NOTE.—Some ice March 12 and 13; discharge not corrected.

Rating table for Willow Creek near Arlington, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.40	10	1.20	35	2.00	100	2.80	224	3.60	421
0.50	12	1.30	41	2.10	112	2.90	244	3.70	454
0.60	14	1.40	48	2.20	125	3.00	265	3.80	489
0.70	16	1.50	55	2.30	139	3.10	286	3.90	526
0.80	19	1.60	63	2.40	154	3.20	309	4.00	565
0.90	22	1.70	72	2.50	170	3.30	334	5.00	965
1.00	25	1.80	81	2.60	187	3.40	361	6.00	1,365
1.10	30	1.90	90	2.70	205	3.50	390	7.00	1,765

NOTE.—The above table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is not well defined.

Monthly discharge of Willow Creek near Arlington, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
March	625	44	115	7,070
April	224	22	71.1	4,230
May	1,640	10	109	6,700
June	725	32	221	13,200
July 1-21	32	19	22.1	920
The period	....	....	....	32,100

NOTE.—Values are rated as follows: May, approximate; remainder of period, fair.

JOHN DAY RIVER DRAINAGE BASIN.

JOHN DAY RIVER AT M'DONALD, OREG.

John Day River rises in the Blue Mountains in northeastern Oregon, at an elevation of about 5,000 feet, and flows northward into Columbia River. The lower 90 miles of the stream flows in a comparatively deep canyon from which it is impracticable to take water for irrigation. The surrounding country is rolling, timberless land, partly cultivated and partly desert. The upper portions of the stream are more broken and mountainous, and large areas are well timbered. The river is fed by innumerable tributaries draining timbered mountain slopes. The main stream is formed by the junction of three important streams called North, Middle, and South forks of John Day River. The rainfall in the drainage area varies from 25 inches on the headwaters to 9 inches at the mouth of the river.

The waters of the numerous mountain tributaries are used extensively for irrigating small valleys, for mining, and for power purposes. Irrigation is not practiced in the lower portion of the stream to any considerable extent.

This station was established November 14, 1901. It is located at the ferry at McDonald, 16 miles above the mouth of the river and 18 miles southwest of Arlington, Oreg. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 203, where are given also references to publications that contain data for previous years.

Discharge measurements of John Day River at McDonald, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
February 6	F. C. Dillard	263	728	2.35	866
February 23	R. S. Hall	282	1,140	3.88	2,990
March 15	do	273	910	3.10	1,710
April 2	F. C. Dillard	319	2,050	6.70	10,500
April 17	J. C. Stevens	314	1,640	5.50	6,840
May 2	R. S. Hall	309	1,430	4.70	4,760
June 8	do	322	1,860	6.16	8,670
July 6	do	278	797	2.69	1,240
November 23	H. McGlashan	268	624	1.97	495

Daily gage height, in feet, of John Day River at McDonald, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.80	2.40	3.80	7.50	4.70	6.98	3.22	1.55	1.45	1.55	1.75	1.70
2	1.90	2.52	3.55	6.72	4.68	6.48	3.08	1.55	1.45	1.55	1.75	1.80
3	1.85	2.58	3.25	6.05	4.62	6.20	2.98	1.55	1.40	1.55	1.75	1.80
4	1.78	2.42	3.15	5.45	4.58	6.10	2.88	1.50	1.40	1.55	1.75	1.85
5	1.80	2.42	3.10	5.35	4.52	6.78	2.78	1.50	1.40	1.55	1.75	1.85
6	1.85	2.35	3.10	5.45	4.55	6.82	2.68	1.50	1.40	1.55	1.75	1.92
7	1.88	2.35	3.05	5.60	4.35	6.55	2.60	1.50	1.40	1.55	1.72	1.95
8	1.90	2.30	3.15	6.00	4.15	6.15	2.50	1.50	1.40	1.55	1.82	2.00
9	1.85	2.20	3.75	5.92	4.05	5.80	2.48	1.45	1.40	1.60	1.85	2.00
10	1.90	2.15	4.15	5.90	3.98	5.70	2.42	1.45	1.35	1.60	1.85	2.10
11	1.90	2.20	4.50	5.85	3.92	5.45	2.42	1.45	1.35	1.60	1.85	2.20
12	1.90	2.18	4.25	5.55	3.98	5.25	2.32	1.45	1.40	1.60	1.92	2.20
13	1.88	2.12	4.75	5.25	3.98	5.05	2.28	1.45	1.40	1.60	2.00	2.15
14	1.90	2.12	3.40	5.05	4.00	4.95	2.20	1.40	1.45	1.60	1.95	2.18
15	1.90	2.20	3.15	5.00	3.80	4.72	2.12	1.82	1.45	1.60	2.00	2.28
16	2.00	2.20	3.10	5.12	3.70	4.55	2.05	1.88	1.45	1.60	1.95	2.20
17	2.00	2.20	3.00	5.35	3.80	4.60	2.00	1.70	1.52	1.60	2.00	2.15
18	2.10	2.28	2.90	5.60	3.65	4.72	2.00	1.65	1.65	1.60	2.40	2.10
19	2.30	2.30	2.95	5.35	3.50	4.50	1.92	1.60	1.75	1.65	2.30	2.00
20	2.18	3.35	3.00	5.12	3.40	4.15	1.90	1.60	1.75	1.65	2.22	2.10
21	2.10	3.88	3.00	5.10	3.28	4.00	1.90	1.50	1.70	1.70	2.20	2.10
22	2.05	3.70	3.00	5.25	3.25	3.88	1.85	1.50	1.70	1.70	2.10	2.20
23	2.00	3.85	3.35	5.60	3.30	3.78	1.80	1.50	1.70	1.70	2.00	2.25
24	2.25	3.50	4.55	5.60	3.40	3.60	1.80	1.45	1.65	1.70	2.00	2.55
25	2.00	3.25	5.05	5.50	3.40	3.50	1.75	1.45	1.60	1.75	2.10	2.68
26	2.95	3.20	6.55	5.35	3.30	3.40	1.70	1.45	1.60	1.75	2.00	2.75
27	2.92	3.10	6.40	5.22	3.40	3.45	1.70	1.45	1.60	1.75	1.95	3.60
28	2.80	3.10	6.55	5.00	3.40	3.30	1.65	1.48	1.60	1.75	1.90	4.10
29	2.58	......	6.30	4.85	3.50	3.35	1.60	1.50	1.60	1.75	1.95	3.75
30	2.50	......	6.10	4.72	3.50	3.40	1.60	1.50	1.60	1.75	1.90	3.45
31	2.42	......	6.50	......	7.85	......	1.60	1.50	......	1.75	......	3.25

Rating table for John Day River at McDonald, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	60	2.00	540	3.00	1,615	3.90	3,050	5.00	7,050
1.10	85	2.10	625	3.10	1,750	4.00	3,240	5.80	7,590
1.20	115	2.20	715	3.20	1,890	4.20	3,650	6.00	8,150
1.30	145	2.30	810	3.30	2,035	4.40	4,090	6.20	8,710
1.40	180	2.40	910	3.40	2,185	4.60	4,550	6.40	9,290
1.50	220	2.50	1,015	3.50	2,345	4.80	5,020	6.60	9,880
1.60	265	2.60	1,125	3.60	2,515	5.00	5,500	6.80	10,480
1.70	320	2.70	1,240	3.70	2,690	5.20	6,000	7.00	11,100
1.80	385	2.80	1,360	3.80	2,870	5.40	6,520	8.00	14,310
1.90	460	2.90	1,485						

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and is well defined below gage height 6.0 feet.

Monthly discharge of John Day River at McDonald, Oreg., for 1906.

[Drainage area, 7,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	1,550	372	672	41,300	0.086	0.10
February	3,0.0	643	1,280	71,100	.164	.17
March	9,730	1,480	3,820	235,000	.490	.56
April	12,700	4,830	6,860	408,000	.879	.98
May	13,800	1,960	3,390	208,000	.435	.50
June	11,000	2,040	5,560	331,000	.713	.80
July	1,920	265	760	46,700	.097	.11
August	445	180	236	14,500	.030	.03
September	352	162	234	13,900	.030	.03
October	352	242	288	17,700	.037	.04
November	910	352	506	30,100	.065	.07
December	3,440	320	969	59,600	.124	.14
The year	13,800	162	2,050	1,480,000	.262	3.53

NOTE.—Values are rated as excellent.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in John Day River drainage basin in 1906:

Canyon Creek at Canyon City, Oreg.—The reference point is a cross cut in the top of a cap of a bent on the right bank downstream side of the highway bridge.

July 2, width, 27 feet; area, 22 square feet; gage height, −8.00 feet; discharge, 50 second-feet.

Rock Creek at Rockcreek, Oreg.—Rockcreek is a station on the Oregon Railroad and Navigation Company's Condon branch, 6 miles above the mouth of the creek. Measurements are made at a highway bridge near the railway station. The reference point is on top of the first projecting beam from the left bank on upstream side of the bridge; elevation, 15 feet above the datum of the assumed gage.

February 6, width, 24 feet; area, 33 square feet; gage height, 5.67 feet; discharge, 35 second-feet.

February 23 width, 40 feet; area, 62 square feet; gage height, 6.48 feet; discharge, 122 second-feet.

March 16, width, 30 feet; area, 53 square feet; gage height, 6.07 feet; discharge, 87 second-feet.

DESCHUTES RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Deschutes River and its tributaries drain the eastern slope of the Cascade Mountains in Oregon. The main stream flows northward parallel to this range and empties into Columbia River 15 miles above The Dalles. Its drainage area may be divided into two parts: The tributaries from the west drain the timbered slopes of the Cascade Range; those from the east drain the timberless areas of high table-lands which are devoted largely to the production of wheat and to ranges for sheep and cattle. The soil throughout is composed of disintegrated lava rock, interlaid with porous lava and basalt, a fact which no doubt accounts for the remarkable constancy in the flow of this river and its tributaries from the west. The maximum discharge is only about four times the minimum. The stream is therefore the most valuable in the State. Its power possibilities are phenomenal, and its upper portions furnish an abundance of water for the irrigation of the fertile table-lands. Its principal tributaries are West Fork, Tumalo Creek, Squaw Creek, Crooked River, Metolius River, Warm Springs, and White River, all of which are used for irrigation, power, and logging purposes.

DESCHUTES RIVER NEAR LAVA, OREG.

This station was established February 17, 1905, about 1 mile north of Lava, Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 212.

Discharge measurements of Deschutes River near Lava, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 14	I. Landes	56.5	181	6.21	317
May 1	do	66.5	231	6.96	422
May 12	do	67.0	248	7.15	485
June 12	do	56.0	215	6.94	413
June 21	J. C. Stevens	61.0	210	6.67	368

Daily gage height, in feet, of Deschutes River near Lava, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.4	5.7	5.3	5.6	7.0	6.65	6.45	5.5	5.2	5.15	5.1	5.45
2	5.35	5.7	5.2	5.6	6.9	6.6	6.4	5.5	5.15	5.15	5.1	5.35
3	5.35	5.7	5.25	5.65	6.9	6.7	6.3	5.5	5.15	5.15	5.1	5.4
4	5.35	5.5	5.2	5.6	6.9	6.65	6.3	5.5	5.15	5.15	5.1	5.45
5	5.45	5.45	5.25	5.7	6.95	6.6	6.35	5.5	5.15	5.15	5.2	5.45
6	5.5	5.4	5.2	5.85	7.0	6.85	6.35	5.45	5.15	5.15	5.3	5.4
7	5.5	5.4	5.2	6.0	7.05	7.0	6.35	5.45	5.15	5.15	5.3	5.4
8	5.5	5.45	5.3	6.1	7.1	7.0	6.35	5.45	5.15	5.15	5.35	5.45
9	5.5	5.4	5.25	6.15	7.15	7.05	6.35	5.4	5.2	5.1	5.55	5.45
10	5.5	5.35	5.2	6.2	7.15	7.1	6.3	5.4	5.2	5.1	5.65	5.4

Daily gage height, in feet, of Deschutes River near Lava, Oreg., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	5.6	5.3	5.35	6.25	7.15	7.15	6.2	5.4	5.25	5.1	5.6	5.4
12	5.6	5.25	5.65	6.25	7.15	7.0	6.2	5.5	5.25	5.15	5.55	5.7
13	5.6	5.15	5.75	6.2	7.2	6.95	6.2	5.45	5.3	5.15	5.0	5.4
14	5.6	5.1	5.5	6.25	7.25	6.85	6.2	5.4	5.3	5.2	5.55	5.3
15	5.6	5.15	5.5	6.35	7.35	6.85	6.15	5.4	5.35	5.2	5.55	5.45
16	5.75	5.15	5.5	6.5	7.35	6.85	6.15	5.4	5.3	5.2	5.65	5.4
17	5.75	5.1	5.55	6.65	7.35	6.85	6.1	5.35	5.3	5.3	5.9	5.35
18	5.8	5.15	5.5	6.82	7.4	6.85	6.1	5.3	5.3	5.3	5.9	5.4
19	5.7	5.65	5.5	6.9	7.35	6.8	6.1	5.3	5.3	5.3	5.9	5.45
20	5.85	5.4	5.5	6.9	7.1	6.75	5.95	5.3	5.25	5.25	5.85	5.5
21	5.9	5.3	5.5	6.95	6.95	6.7	5.95	5.3	5.2	5.2	5.85	5.65
22	5.95	5.35	5.55	7.05	6.8	6.6	5.85	5.3	5.2	5.2	5.8	5.7
23	5.95	5.4	5.7	7.18	6.75	6.55	5.8	5.35	5.2	5.15	5.7	5.65
24	5.95	5.45	5.6	7.28	6.65	6.5	5.75	5.3	5.2	5.15	5.45	5.75
25	6.1	5.4	5.75	7.35	6.65	6.45	5.75	5.3	5.2	5.15	5.45	5.85
26	6.1	5.3	5.7	7.35	6.6	6.5	5.7	5.3	5.2	5.1	5.45	5.85
27	6.1	5.3	5.6	7.35	6.6	6.5	5.65	5.25	5.2	5.1	5.45	5.9
28	6.1	5.4	5.7	7.25	6.8	6.45	5.65	5.25	5.2	5.1	5.45	6.0
29	6.1	....	5.7	7.2	6.85	6.45	5.65	5.2	5.2	5.1	5.45	5.9
30	5.9	....	5.8	7.1	7.0	6.45	5.6	5.2	5.2	5.1	5.45	5.8
31	5.9	....	5.85	....	7.05	....	5.55	5.2	....	5.1	....	5.8

NOTE.—From January 1 to March 22 there was some obstruction from ice, which formed and then went out again, sometimes reaching a thickness of 0.6 foot. There was also some ice November 23 to December 8. Discharges have been applied as for open channel.

Rating table for Deschutes River near Lava, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
4.80	76	5.40	125	6.00	205	6.60	329	7.20	498
4.90	82	5.50	135	6.10	223	6.70	355	7.30	528
5.00	89	5.60	147	6.20	242	6.80	382	7.40	559
5.10	97	5.70	160	6.30	262	6.90	410		
5.20	106	5.80	173	6.40	283	7.00	430		
5.30	115	5.90	188	6.50	305	7.10	468		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 11 discharge measurements made during 1905–6 and is well defined between gage heights 6.0 feet and 7.5 feet. Below gage height 6 feet the measurements are inconsistent.

Monthly discharge of Deschutes River near Lava, Oreg., for 1906.

[Drainage area, 880 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	223	120	166	10,200	0.189	0.22
February	160	97	123	6,830	.140	.15
March	180	106	136	8,360	.155	.18
April	544	147	332	19,800	.377	.42
May	559	329	445	27,400	.506	.58
June	483	294	369	22,000	.419	.47
July	294	141	220	13,500	.250	.29
August	135	106	122	7,500	.139	.16
September	120	102	108	6,430	.123	.14
October	115	97	103	6,330	.117	.13
November	188	89	137	8,150	.156	.17
December	205	115	144	8,850	.164	.19
The year	559	89	200	145,000	.228	3.10

NOTE.—Values are rated as fair.

DESCHUTES RIVER AT WEST'S RANCH, NEAR LAVA, OREG.

This station was established June 20, 1906. It is located at a private bridge on B. F. West's ranch, 16 miles above Bend. It is below the mouth of West Fork and of Spring River and above all important diversions.

The channel is straight for 200 feet above and 100 feet below the station. The right bank is low, sparsely wooded, and liable to overflow at rare intervals; the left is high and rocky and will not overflow. The bed of the stream is partly of rock and partly of gravel, and will change only during floods.

Measurements are made from a private highway bridge constructed of logs. The initial point is a mark on the guardlog of the bridge, nearly over the gage.

The gage, which is read by B. F. West, is a 2 by 4 inch timber spiked to the approach on the right bank. The bench mark is a spike in the north side of the base of a lone yellow pine, 75 feet upstream from the bridge on the left bank; elevation, 17.44 feet above the datum of the gage.

Discharge measurements of Deschutes River at West's ranch, near Lava, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 13	I. Landes	107	588	9.08	1,590
May 20	do	110	652	9.42	1,920
June 12	do	110	649	9.39	1,910
June 20	Stevens and Landes	110	626	9.30	1,780
August 23	C. W. Allen	105	576	8.85	1,400

Daily gage height, in feet, of Deschutes River at West's ranch, near Lava, Oreg., for 1906.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		8.9	8.8	8.8	8.7	8.75	17		8.85	8.85	8.75	8.95	8.8
2		8.9	8.8	8.8	8.7	8.75	18		8.85	8.85	8.75	9.0	8.8
3		8.9	8.8	8.8	8.7	8.75	19		8.85	8.85	8.75	8.95	8.85
4		8.9	8.8	8.8	8.7	8.75	20		8.85	8.8	8.75	8.9	8.85
5		8.9	8.8	8.75	8.75	8.75	21	9.0	8.85	8.8	8.75	8.9	8.85
6		8.9	8.8	8.75	8.75	8.75	22	9.0	8.85	8.8	8.75	8.9	8.9
7		8.9	8.8	8.75	8.8	8.8	23	8.98	8.85	8.8	8.7	8.8	8.9
8		8.9	8.8	8.75	8.8	8.8	24	8.95	8.85	8.8	8.7	8.8	8.9
9		8.9	8.8	8.75	8.8	8.8	25	8.95	8.85	8.8	8.7	8.82	8.9
10		8.9	8.8	8.75	8.88	8.8	26	8.95	8.85	8.8	8.7	8.75	8.98
11		8.9	8.8	8.75	8.85	8.8	27	8.95	8.85	8.8	8.7	8.7	9.0
12		8.9	8.8	8.78	8.85	8.75	28	8.95	8.85	8.8	8.7	8.72	9.0
13		8.9	8.82	8.75	8.8	8.75	29	8.95	8.8	8.8	8.7	8.72	8.95
14		8.9	8.85	8.75	8.8	8.8	30	8.92	8.8	8.8	8.7	8.75	8.95
15		8.85	8.85	8.75	8.85	8.8	31	8.90	8.8		8.7		8.9
16		8.85	8.85	8.75	8.9	8.78							

Rating table for Deschutes River at West's ranch, near Lava, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
8.70	1,290	8.90	1,430	9.10	1,590	9.30	1,780	9.40	1,900
8.80	1,360	9.00	1,510	9.20	1,680				

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and is well defined.

Monthly discharge of Deschutes River at West's ranch, near Lava, Oreg., for 1906.

[Drainage area, 1,240 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
July 21-31	1,510	1,430	1,470	32,100	1.19	0.49
August	1,430	1,360	1,410	86,700	1.14	1.31
September	1,400	1,360	1,370	81,500	1.10	1.23
October	1,360	1,290	1,320	81,200	1.06	1.22
November	1,510	1,290	1,370	81,500	1.10	1.23
December	1,510	1,320	1,390	85,500	1.12	1.29
The period				448,000		

NOTE.—Values are rated as excellent.

DESCHUTES RIVER AT BEND, OREG.

This station was established December 22, 1904. It is located at the wagon bridge known as Sizemore's bridge, 1½ miles south of Bend, Oreg.

On account of backwater from logs and other disturbing influences the gage heights at this station are no index of the discharge, which is practically the same as at West's ranch. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 208, where are given also references to publications that contain data for previous years.

Discharge measurements of Deschutes River at Bend, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19	I. Landes	370.5	747	1.78	1,680
June 19	J. C. Stevens	376	883	2.11	1,880

DESCHUTES RIVER NEAR BIGGS, OREG.

This station was established July 7, 1906. It is located at Taylor's ranch, 1½ miles above the junction of the river with the Columbia, about the same distance above the Oregon Railroad and Navigation Company's bridge, and 1 mile above Moody's toll bridge.

The channel is straight; the banks are overgrown with alder and not liable to overflow. The bed of the stream is of rock and gravel, free from vegetation, and liable to shift slightly. There is but one channel at all stages. There is a good even current at the gaging section; a little lower down it is considerably broken by falls and riffles.

Measurements are made from a car and cable of 490 feet span. The initial point for soundings is 8 feet from the inside of the shear leg on the left bank. There is a tagged wire overhead and a stay-line 100 feet upstream.

The gage, which is read by Wilbur Taylor, is 150 yards below the point of measurement, on the right bank. It is in two sections and is bolted to alder trees. The bench mark is the top of three 20-penny nails driven into the trunk of the alder tree to which the lower part of the gage is anchored; elevation, 5.46 feet above the datum of the gage.

Discharge measurements of Deschutes River near Biggs, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 7	L. R. Allen	452	1,610	2.63	6,010
August 30	do	449	1,550	2.34	5,140
September 29	I. E. Oakes	435	1,530	2.30	5,000
October 18	Stevens and Oakes	450	1,530	2.35	5,320
December 17	H. D. McGlashan	449	1,650	2.64	5,710

Daily gage height, in feet, of Deschutes River near Biggs, Oreg., for 1906.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.4	2.3	2.3	2.35	2.56
2		2.4	2.3	2.3	2.35	
3		2.4	2.3	2.3	2.35	2.55
4		2.4	2.3	2.3	2.35	
5		2.4	2.3	2.3	2.35	2.55
6		2.4	2.3	2.3	2.35	2.56
7		2.4	2.3	2.3	2.45	
8		2.4	2.3	2.3	3.25	2.66
9		2.4	2.3	2.3		
10		2.4	2.3	2.3	2.9	2.62
11		2.4	2.3	2.3	3.0	2.6
12		2.4	2.3	2.3		
13		2.4	2.3	2.3	3.8	2.58
14		2.4	2.3	2.3	3.65	
15		2.4	2.3	2.3	4.1	2.55
16		2.4	2.3	2.3	3.9	
17		2.4	2.3	2.3	3.6	2.63
18		2.4	2.3	2.35	3.46	
19		2.4	2.3	2.35		2.65
20		2.4	2.3	2.35	3.1	
21		2.4	2.3	2.35	2.85	3.5
22	2.4	2.4	2.3	2.35	2.75	3.25
23	2.4	2.4	2.3	2.35		
24	2.4	2.4	2.3	2.35	2.7	3.15
25	2.4	2.4	2.3	2.35		3.1
26	2.4	2.4	2.3	2.35	2.65	
27	2.4	2.4	2.3	2.56		3.05
28	2.4	2.4	2.3	2.4	2.6	
29	2.4	2.4	2.3	2.39		3.03
30	2.4	2.4	2.3	2.36	2.58	3.0
31	2.4	2.4		2.35		2.98

Rating table for Deschutes River near Biggs, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.30	5,140	2.70	6,060	3.10	7,020	3.50	8,000	3.90	9,000
2.40	5,370	2.80	6,300	3.20	7,260	3.60	8,250	4.00	9,250
2.50	5,600	2.90	6,540	3.30	7,500	3.70	8,500	4.10	9,500
2.60	5,830	3.00	6,780	3.40	7,750	3.80	8,750		

Note.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and is fairly well defined below gage height 2.7 feet.

Monthly discharge of Deschutes River near Biggs, Oreg., for 1906.

[Drainage area, 9,180 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
July 22-31	5,370	5,370	5,370	106,000	0.585	0.22
August	5,370	5,370	5,370	330,000	.585	.67
September	5,140	5,140	5,140	306,000	.560	.62
October	5,740	5,140	5,220	321,000	.569	.66
November	9,500	5,260	6,640	395,000	.723	.81
December	8,000	5,720	6,360	391,000	.693	.80
The period				1,850,000		

Note.—Values are rated as fair.

EAST FORK OF DESCHUTES RIVER AT ODELL, OREG.

This station was established December 25, 1904, at Odell postoffice. The conditions and the bench marks are described in Water-Supply Paper No. 178, page 210, where are given also references to publications that contain data for previous years.

Discharge measurements of East Fork of Deschutes River at Odell, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 11	I. Landes	24	34	2.70	63
May 21	do	25	43	3.15	101
June 14	do	25.5	47	[a] 3.40	118
June 21	Stevens and Landes	25.5	44	3.15	109

[a] Gage height uncertain.

Daily gage height, in feet, of East Fork of Deschutes River at Odell, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.1	3.2	3.1	2.6	3.25	3.1	3.0	2.4	2.2	2.2	2.2	2.75
2	3.1	3.2	2.7	2.6	3.25	3.1	3.0	2.4	2.2	2.2	2.2	2.65
3	3.0	3.2	3.05	2.92	3.3	3.1	2.9	2.4	2.2	2.2	2.2	2.7
4	3.0	2.8	3.1	2.6	3.35	3.2	3.0	2.3	2.2	2.2	2.8	2.75
5	3.0	2.8	3.0	2.55	3.4	3.3	3.1	2.3	2.2	2.2	2.3	2.5
6	3.0	3.1	2.9	2.75	3.5	3.4	3.1	2.3	2.5	2.2	2.4	2.5
7	3.0	2.9	2.9	2.5	3.5	3.3	3.0	2.2	2.5	2.2	2.6	2.5
8	3.0	2.9	3.0	2.8	3.45	3.3	2.9	2.2	2.5	2.2	2.4	2.5
9	3.0	2.8	2.9	2.85	3.5	3.3	2.8	2.2	2.5	2.2	2.4	2.5
10	2.8	2.9	2.85	2.85	3.55	3.2	2.8	2.2	2.5	2.2	2.4	2.5
11	2.8	3.0	2.9	2.7	3.55	3.2	2.75	2.2	2.5	2.2	2.65	2.7
12	2.8	3.1	2.8	2.7	3.0	3.3	2.75	2.3	2.5	2.2	2.65	2.6
13	2.9	3.1	2.5	2.75	3.6	3.3	2.7	2.3	2.3	2.2	2.65	2.5
14	2.9	3.1	3.0	2.8	3.7	3.4	2.7	2.3	2.4	2.2	2.65	2.5
15	3.1	3.0	2.9	2.9	3.7	3.4	2.7	2.3	2.4	2.2	2.4	2.4
16	3.1	3.0	2.8	3.0	3.6	3.5	2.7	2.3	2.8	2.2	2.7	2.5
17	2.4	3.1	2.7	3.0	3.4	3.5	2.7	2.3	2.8	2.65	2.6	2.5
18	2.2	3.2	2.7	3.0	3.3	3.4	2.7	2.3	2.3	2.3	2.65	2.5
19	2.2	3.2	2.8	3.0	3.1	3.2	2.6	2.3	2.3	2.3	2.4	2.6
20	2.18	3.35	2.8	3.0	3.0	3.1	2.6	2.3	2.2	2.3	2.6	2.5
21	3.5	3.5	2.3	3.3	3.1	3.1	2.65	2.3	2.2	2.65	2.6	2.5
22	3.0	3.3	2.85	3.4	3.1	3.1	2.5	2.3	2.2	2.65	2.55	2.45
23	3.4	3.3	3.2	3.4	2.9	3.1	2.5	2.3	2.2	2.65	2.5	2.4
24	3.4	3.0	3.1	3.4	2.9	3.0	2.5	2.5	2.2	2.65	2.68	2.45
25	3.4	2.85	3.1	3.45	2.9	3.0	2.5	2.5	2.2	2.2	2.65	2.5
26	3.4	2.85	3.0	3.3	3.0	3.0	2.45	2.5	2.2	2.2	2.85	2.7
27	2.9	2.8	3.0	3.25	3.0	3.0	2.45	2.5	2.2	2.2	2.85	2.6
28	3.2	3.25	2.75	3.25	3.3	3.0	2.45	2.5	2.2	2.2	2.65	2.5
29	3.2	......	2.65	3.2	3.2	3.0	2.45	2.2	2.2	2.2	2.7	2.5
30	3.2	......	2.7	3.25	3.2	3.0	2.4	2.2	2.2	2.2	2.65	2.5
31	3.2	......	3.1	......	3.1	......	2.4	2.2	......	2.2	......	2.4

Rating table for East Fork of Deschutes River at Odell, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.10	24	2.50	49	2.90	81	3.30	121	3.70	174
2.20	30	2.60	56	3.00	90	3.40	133		
2.30	36	2.70	64	3.10	100	3.50	146		
2.40	42	2.80	72	3.20	110	3.60	160		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 3 discharge measurements made during 1906 and the form of previous curves and is fairly well defined.

Monthly discharge of East Fork of Deschutes River at Odell, Oreg., for 1906.

[Drainage area, 196 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	146	29	88.8	5,460	0.454	0.52
February	146	72	97.6	5,420	.498	.52
March	110	60	80.8	4,970	.413	.48
April	140	49	89.7	5,340	.458	.51
May	174	81	124	7,620	.633	.73
June	146	90	110	6,540	.562	.63
July	100	42	65.2	4,010	.333	.38
August	49	30	37.8	2,320	.196	.23
September	49	30	36.2	2,150	.185	.21
October	60	30	35.4	2,180	.182	.21
November	77	30	52.0	3,090	.265	.30
December	68	42	52.0	3,200	.265	.31
The year	174	29	73.0	52,300	.522	5.03

NOTE.—Values are rated as fair.

WEST FORK OF DESCHUTES RIVER NEAR LAVA, OREG.

This station was established February 20, 1905, about 1½ miles west of Lava, Oreg. The conditions and the bench marks are described in Water-Supply Paper No. 178, page 214, where are given also references to publications that contain data for previous years.

Discharge measurements of West Fork of Deschutes River near Lava, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 13	I. Landes	99	453	7.91	910
May 2	do	100	468	8.10	880
May 13	do	100	485	8.30	942
June 11	do	101	485	8.39	955
June 21	Stevens and Landes	101	484	8.26	914

Daily gage height, in feet, of West Fork of Deschutes River near Lava, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		7.52						8.05				
2	8.01	7.50								8.10	7.90	
3		7.50	7.50									
4	7.70	7.50					8.15					
5	7.62	7.50			8.50	8.35		8.10		8.00		
6	7.62	7.50										
7	7.65	7.50		7.80					8.01			
8	7.60	7.50			8.15							8.10
9	7.60	7.50								8.00	8.00	
10	7.60	7.50	7.60									
11	7.60	7.50					8.15				8.00	
12	7.60	7.50				8.40		8.15		8.10	7.90	
13	7.70	7.50			8.30							
14	7.65	7.50		8.00					8.20			
15	7.65	7.50										7.90
16	7.85	7.50								8.10	8.10	
17	7.62	7.55	7.40		8.40							
18	7.70	7.62					8.15					
19	7.66	7.70						8.10		8.00		
20	7.60	7.65			8.30							

Daily gage height. in feet, of West Fork of Deschutes River near Lava, Oreg., in 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	7.55	7.60				8.26			8.01			
22	7.60	7.60										7.70
23	7.65	7.60										
24	7.66	7.60	7.50			8.20	8.10				7.95	
25	7.60	7.60										
26	7.60					8.25		8.15		7.95		
27	7.58											
28	7.55	7.50		8.20					8.01			
29	7.55											8.00
30	7.55										7.90	
31	7.55		7.75					8.15				

NOTE.—There was some floating ice during January.

Rating tables for West Fork of Deschutes River near Lava, Oreg.

JANUARY 1, 1905, TO APRIL 30, 1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
7.40	837	7.60	867	7.80	902	8.00	942	8.20	984
7.50	852	7.70	883	7.90	922	8.10	963		

MAY 1 TO DECEMBER 31, 1906.[b]

7.50	727	7.80	802	8.10	879	8.40	958	8.50	985
7.60	752	7.90	827	8.20	905				
7.70	777	8.00	853	8.30	931				

[a] This table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905–6 and is well defined above gage height, 7.7 feet.

[b] This table is applicable only for open-channel conditions. It is based on 4 discharges measurements made during 1906 and is well defined above gage height 8.1 feet. The table has been extended beyond these limits.

Monthly discharge of West Fork of Deschutes River near Lava, Oreg., for 1906.

[Drainage area, 360 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
January	944	860	874	53,700	2.43	2.80
February	883	852	858	47,700	2.38	2.48
March	892	837	860	52,900	2.39	2.76
April	984	902	943	56,100	2.62	2.92
May	985	892	939	57,700	2.61	3.01
June	958	905	929	55,300	2.58	2.88
July	892	879	889	54,700	2.47	2.85
August	892	866	883	54,300	2.45	2.82
September	905	856	868	51,600	2.41	2.69
October	879	840	862	53,000	2.39	2.76
November	879	827	844	50,200	2.34	2.61
December	879	777	834	51,300	2.32	2.68
The year	985	777	882	638,000	2.45	33.26

NOTE.—Owing to the steady flow of the river the mean discharge for the days of each month when the gage was read has been taken as the mean for the month. Values are good.

CENTRAL OREGON AND PILOT BUTTE CANALS, NEAR BEND, OREG.

These canals have a common head-gate and are operated by the Deschutes Irrigation and Power Company, under the provisions of the Carey Act. They divert water from Deschutes River about 3 miles above Bend. Measurements are made 2,000 feet below dividing point. The conditions at these stations are described in Water-Supply Paper No. 178, pages 216–217.

Discharge measurements of Central Oregon canal near Bend, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	I. Landes	13.3	11	0.80	35
May 18	do	13.3	17	1.25	66
June 10	do	13.3	19	1.45	86
June 19	J. C. Stevens	13.4	19	1.44	92
June 19	I. Landes	13.4	19	1.44	90
June 19	L. R. Allen	13.4	19	1.44	87
August 22	C. W. Allen	13.3	25	1.87	134

Daily gage height, in feet, of Central Oregon canal near Bend, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	1.35	1.25	1.25	.80	1.25	1.58	1.80	1.87	1.84	1.68	1.09
2	....	1.25	.90	1.25	....	1.25	1.58	1.80	1.88	1.84	1.65	.98
3	.38	1.60	1.15	1.25	1.12	1.25	1.58	1.80	1.87	1.82	1.59	.96
4	.90	1.60	1.30	1.25	1.30	1.25	1.58	1.80	1.87	1.84	1.08	.98
5	.90	1.20	1.20	1.25	1.20	1.25	1.61	1.80	1.87	1.84	1.09	1.09
6	.90	.95	.60	1.25	1.20	1.25	1.64	1.80	1.87	1.84	1.6	1.19
7	1.00	.65	.60	1.25	.60	1.25	1.64	1.80	1.87	1.84	1.48	1.20
8	.55	.65	.60	1.12	.60	1.35	1.65	1.80	1.86	1.84	1.10	1.20
9	....	.65	.90	.90	1.20	1.45	1.65	1.80	1.87	1.84	1.02	1.20
10	....	.65	.90	.82	1.22	1.45	1.67	1.80	1.87	1.84	0.51	1.20
11	....	.32	....	.85	1.20	1.45	1.69	1.80	1.87	1.83	....	1.29
12	.62	.33	.35	1.20	1.20	1.45	1.85	1.80	1.87	1.83	....	1.29
13	.43	.32	.45	1.25	1.20	1.45	1.84	1.80	1.85	1.84	....	1.29
14	1.42	.65	....	1.25	1.20	1.45	1.85	1.80	1.84	1.84	1.00	1.38
15	1.50	1.10	....	1.25	1.20	1.45	1.85	1.80	1.84	1.84	1.40	1.54
16	1.20	.65	....	.62	1.20	1.45	1.77	1.87	1.84	1.82	1.60	1.55
17	....	....	....	.40	1.20	1.45	1.70	1.87	1.84	1.80	1.58	1.55
18	....	....	....	.78	1.20	1.45	1.70	1.87	1.84	1.77	....	1.55
19	....	....	....	.90	1.20	1.45	1.70	1.87	1.84	1.77	.20	1.55
20	....	....	....	.85	1.10	1.45	1.70	1.87	1.84	1.77	.62	1.55
21	....	....	....	.75	1.10	1.45	1.70	1.87	1.84	1.76	.98	1.55
22	....	....	....	.75	1.10	1.48	1.70	1.87	1.84	1.77	.38	1.55
23	....	....	....	.78	1.10	1.53	1.70	1.87	1.82	1.77	.40	1.55
24	....	....	....	.75	1.10	1.53	1.70	1.87	1.84	1.77	.60	1.38
25	1.50	....	.55	.80	1.10	1.53	1.70	1.77	1.84	1.76	.77	1.29
26	1.40	....	1.05	.82	1.10	1.53	1.80	1.77	1.84	1.76	.90	1.29
27	1.25	.50	1.05	.85	1.25	1.53	1.80	1.82	1.84	1.77	1.00	1.29
28	1.50	.50	1.12	.92	1.25	1.53	1.88	1.87	1.84	1.77	1.10	1.29
29	1.40	....	1.20	1.20	1.25	1.53	1.81	1.88	1.84	1.77	1.20	1.29
30	1.40	....	1.25	1.20	1.25	1.53	1.80	1.87	1.82	1.77	1.20	1.29
31	1.52	....	1.25	....	1.25	....	1.79	1.87	....	1.72	....	....

Note.—The canal was dry on days when the gage height was not recorded.

Rating table for Central Oregon canal near Bend, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	0	0.40	12	0.80	34	1.20	65	1.60	105
0.10	2	0.50	17	0.90	41	1.30	74	1.70	116
0.20	5	0.60	22	1.00	48	1.40	84	1.80	128
0.30	8	0.70	28	1.10	56	1.50	94	1.90	140

Note.—The above table is based on 12 discharge measurements made during 1905–6 and is well defined.

Monthly discharge of Central Oregon canal near Bend, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	96	0	35.2	2,160
February	105	0	26.2	1,460
March	74	0	28.0	1,720
April	70	12	49.6	2,950
May	74	0	58.0	3,570
June	97	70	86.5	5,150
July	138	103	118	7,260
August	138	124	131	8,060
September	138	130	134	7,970
October	133	118	128	7,870
November	114	0	48.5	2,890
December	100	47	73.8	4,540
The year	138	0	76.4	55,600

NOTE.—Values are rated as good.

Discharge measurements of Pilot Butte canal near Bend, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 18	I. Landes	31.5	33	1.85	37
May 18	do	33	42	2.10	62
June 10	do	33	51	2.30	95
June 18	L. R. Allen	44	58	2.30	99
June 19	J. C. Stevens	34	52	2.30	99

Daily gage height, in feet, of Pilot Butte canal near Bend, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.95		1.85	2.05	2.15	2.44	2.60	2.28	2.46	1.52	1.40
2		1.95	1.85	1.50	2.05	2.15	2.44	2.62	2.45	2.45		1.36
3	.88		1.95	1.50	2.05	2.15	2.44	2.60	2.46	2.43	1.37	1.40
4	1.85		1.90	1.62	2.10	2.10	2.44	2.60	2.46	2.44	1.34	1.59
5	.98		1.85	1.50	2.15	2.30	2.44	2.60	2.46	2.46	1.38	1.79
6	1.95		1.85	1.50	2.15	2.30	2.44	2.60	2.46	2.46	1.38	1.60
7	1.95		1.85	1.62	2.15	2.30	2.51	2.60	2.46	2.46	1.80	1.75
8		1.95	1.82	1.62	2.15	2.30	2.56	2.60	2.46	2.46	2.26	1.90
9		1.95	1.73	1.84	2.15	2.30	2.60	2.60	2.46	2.46		1.90
10	1.90	1.95	1.82	2.18	2.22	2.30	2.60	2.60	2.46	2.46		1.64
11	1.80	1.95		2.30	2.35	2.30	2.60	2.60	2.46	2.45	1.10	1.40
12	.95	1.95		2.30	2.35	2.30	2.60	2.60	2.46	2.44	1.36	1.40
13		1.85		2.05	2.40	2.30	2.60	2.00	2.46	2.44	1.14	1.40
14		1.85		2.05	2.40	2.30	2.60	2.60	2.46	2.46	1.06	1.39
15		1.85		2.05	2.40	2.30	2.60	2.60	2.46	2.46	1.02	1.42
16		1.85		2.00	2.40	2.30	2.60	2.60	2.46	2.44	1.48	1.74
17		1.85		2.45	2.40	2.30	2.60	2.60	2.46	2.46	1.38	1.90
18		1.85		2.45	2.05	2.30	2.60	2.60	2.46	2.46	1.42	1.90
19		1.85		1.95	2.05	2.30	2.60	2.60	2.46	2.46	1.42	1.92
20		1.85		1.95	2.05	2.30	2.59	2.59	2.46	2.46	1.51	1.92
21		1.85		1.95	2.10	2.30	2.60	2.60	2.46	2.46	1.74	1.92
22		1.85		1.95	2.15	2.30	2.60	2.60	2.46	2.46	1.59	1.92
23		1.85		1.78	2.15	2.30	2.59	2.60	2.43	1.73	1.64	1.92
24		1.85	1.78	2.05	2.15	2.37	2.60	2.60	2.46	1.62	2.10	1.92
25		1.85	1.95	2.05	2.15	2.42	2.60	2.60	2.46	2.29	2.10	1.92
26	1.50	1.90	1.90	2.05	2.15	2.44	2.60		2.46	2.30	2.10	1.92
27	1.75	.97	1.95	2.05	2.20	2.44	2.60	2.60	2.46	2.30	1.75	1.92
28	.90	.98		2.05	2.20	2.44	2.59	2.58	2.46	2.30	1.40	1.92
29	.95		.85	2.05	2.35	2.44	2.60		2.46	2.30	1.38	1.92
30	1.80			2.05	2.40	2.44	2.58	2.18	2.44	2.30	1.40	1.92
31	1.70				1.78		2.35	1.91		2.30		1.66

NOTE.—The canal was dry on days when the gage height was not recorded.

Rating table for Pilot Butte canal near Bend, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	2	1.30	7	1.70	25	2.10	61	2.50	145
1.00	2	1.40	10	1.80	33	2.20	77	2.60	175
1.10	3	1.50	13	1.90	41	2.30	97		
1.20	5	1.60	18	2.00	49	2.40	120		

NOTE.—The above table is based on discharge measurements made during 1905–6, and is well defined between gage heights 1.7 feet and 2.3 feet.

Monthly discharge of Pilot Butte canal near Bend, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
January	45	0	10.0	615
February	45	0	30.0	1,670
March	45	0	16.0	984
April	132	13	50.8	3,020
May	120	31	79.1	4,860
June	130	69	100	5,950
July	175	108	162	9,960
August	181	0	156	9,590
September	135	93	133	7,910
October	135	19	118	7,260
November	77	2	19.3	1,150
December	43	9	29.9	1,840
The year	181	0	75.3	54,800

NOTE.—Values are rated as fair.

TUMALO CREEK NEAR LAIDLAW, OREG.

This station was established May 15, 1906. It is located about one-half mile above the head-gate of the Columbia Southern Canal, in sec. 2, T. 18 S., R. 10 E.

The channel is straight; neither bank is liable to overflow, and there is one channel at all stages.

Measurements are made from a footlog. The initial point is a notch cut in the left end of the log.

The gage, which is read voluntarily by G. W. Updike, the ditch tender, is a 1 by 4 inch pine board, graduated with brass tacks, driven in the left bank at the water's edge on the upstream side of the footlog. The bench mark is on top of a fir stump 5 feet from the left bank; elevation, 6.67 feet above the datum of the gage.

Discharge measurements of Tumalo Creek near Laidlaw, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	I. Landes	39	59	2.19	218
June 9	do	37	46	1.85	144
June 16	L. R. Allen	36	61	2.23	236
June 18	Stevens and Landes	37	55	2.08	202

Daily gage height, in feet, of Tumalo Creek near Laidlaw, Oreg., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	......	1.85	2.50	1.55	1.50	1.50	17	2.20	2.30	1.65	1.50	1.50	1.55
2	......	2.10	2.65	1.55	1.50	1.65	18	2.40	2.35	1.55	1.50	1.50	1.55
3	......	2.25	2.60	1.50	1.50	1.60	19	2.50	2.40	1.65	1.50	1.50	1.52
4	......	2.15	2.70	1.50	1.50	1.60	20	2.00	2.45	1.70	1.50	1.50	1.52
5	......	1.95	2.60	1.50	1.50	1.55	21	1.95	2.25	1.70	1.50	1.50	1.50
6	......	1.90	2.45	1.50	1.50	1.52	22	1.90	2.20	1.65	1.50	1.50	1.50
7	......	1.80	2.45	1.50	1.50	1.52	23	1.92	2.20	1.65	1.50	1.50	1.50
8	......	1.85	2.40	1.55	1.50	1.52	24	2.00	2.18	1.60	1.50	1.50	1.50
9	......	1.85	2.20	1.55	1.50	1.50	25	2.50	2.60	1.60	1.50	1.50	1.55
10	......	1.80	2.15	1.55	1.50	1.65	26	1.95	2.40	1.60	1.50	1.50	2.15
11	......	2.10	2.15	1.55	1.50	1.85	27	1.90	2.10	1.60	1.50	1.50	1.65
12	......	2.15	2.10	1.55	1.50	1.70	28	1.95	1.90	1.60	1.50	1.50	1.60
13	......	2.10	2.10	1.55	1.62	1.70	29	1.85	2.05	1.60	1.50	1.50	1.55
14	......	2.00	1.95	1.55	1.58	1.67	30	1.80	2.20	1.60	1.50	1.50	1.55
15	2.19	2.55	1.85	1.55	1.50	1.80	31	1.80	......	1.60	1.50	......	1.55
16	2.90	2.45	1.75	1.50	1.50	1.65							

Rating table for Tumalo Creek near Laidlaw, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.50	80	1.90	155	2.20	230	2.50	315	2.80	415
1.60	95	2.00	180	2.30	255	2.60	345	2.90	450
1.70	115	2.10	205	2.40	285	2.70	380	3.00	490
1.80	135								

NOTE.—The above table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is well defined between gage heights 1.7 feet and 2.5 feet.

Monthly discharge of Tumalo Creek near Laidlaw, Oreg., for 1906.

[Drainage area, 90 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
May 15-31	450	135	210	7,080	2.34	1.48
June	345	135	219	13,000	2.44	2.72
July	380	88	182	11,200	2.01	2.32
August	88	80	82.6	5,080	.918	1.06
September	99	80	81.0	4,820	.900	1.00
October	218	80	98.5	6,060	1.09	1.26
The period	....	....	....	47,200	....	....

NOTE.—To give the natural flow at this station, the discharge of Wymer canal should be added. Values are rated as good.

TUMALO CREEK NEAR BEND, OREG.

This station was established October 6, 1906, to take the place of the station on Tumalo Creek near Laidlaw during the winter months when no gage reader is available at the latter place. It is located at the highway bridge on the Bend-Sisters road, about 5 miles from Bend, Oreg.

The channel is straight for 175 feet above and 300 feet below the station. The right bank is high; the left, low. There is a single channel.

The gage, which is read by W. P. Downing, is a pine board attached to the river face of the abutment at the southeast corner of the bridge.

Discharge measurements of Tumalo Creek near Bend, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 13	Ivan Landes	24	31	1.23	53
April 19	do	26	35	1.52	80
October 6	C. L. Swain	......	......	.40	[a] 8

[a] Estimated.

Daily gage height, in feet, of Tumalo Creek near Bend, Oreg., for 1906.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	......	1.4	1.6	12	0.80	1.8	1.45	23	0.35	1.4	1.65
2	......	1.35	1.6	13	.52	2.9	1.5	24	.65	1.5	1.65
3	......	1.4	1.5	14	.60	3.8	1.5	25	.75	1.55	1.6
4	......	1.4	1.4	15	.50	2.2	1.5	26	2.00	1.6	1.6
5	......	1.4	1.45	16	.78	1.9	1.45	27	.95	1.7	1.5
6	0.40	1.45	1.4	17	.32	1.75	1.4	28	.80	1.75	1.5
7	.40	2.2	1.3	18	.32	1.8	1.4	29	.75	2.0	1.5
8	.42	2.45	1.3	19	.31	2.1	1.35	30	.75	1.9	1.45
9	.40	1.5	1.35	20	.30	1.5	1.35	31	.80	......	1.6
10	.40	3.1	1.4	21	.32	1.5	1.5				
11	.38	1.85	1.4	22	.35	1.4	1.6				

WYMER CANAL NEAR LAIDLAW, OREG.

Wymer canal takes water from Tumalo Creek just above the gaging station on the latter. A gaging station was established on the canal June 16, 1906, in order to determine the total water supply of the creek. It is located just below the headgates.

The bed and banks are of loam and gravel.

Measurements are made from two logs. The gage is a vertical staff and is read by G. W. Updike. The bench mark is on a bench on a fir tree, about 16 inches in diameter, 25 feet below the headgate, and 3 feet from the right bank; elevation, 4.12 feet above the datum of the gage.

Discharge measurements of Wymer canal near Laidlaw, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	I. Landes	5.5	9	......	12
June 9	do	4	3.2	......	8.5
June 16	L. R. Allen	16	22	1.90	41
June 18	Stevens and Landes	15.5	20	1.85	43

Daily gage height, in feet, of Wymer canal near Laidlaw, Oreg., for 1906.

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1	......	2.05	1.00	0.88	1.00	17	1.95	1.45	0.88	0.88	1.10
2	......	2.10	1.00	.88	1.30	18	1.95	1.45	.88	.88	1.10
3	......	2.05	.95	.88	1.20	19	2.00	1.45	.88	.88	1.10
4	......	2.15	.95	.88	1.10	20	2.00	1.50	.88	.88	1.10
5	......	2.05	.95	.88	1.10	21	1.95	1.45	.88	.88	1.05
6	......	2.05	.95	.88	1.06	22	1.90	1.40	.88	.88	1.05
7	......	2.05	.95	.88	1.06	23	1.90	1.40	.88	.88	1.10
8	......	2.00	.95	.88	1.04	24	1.90	1.15	.88	.88	1.15
9	......	1.95	.95	.88	1.02	25	2.10	1.05	.88	.88	1.20
10	......	1.90	.95	.88	......	26	2.05	1.05	.88	.88	2.20
11	......	1.90	.95	.88	......	27	1.95	1.05	.88	.88	1.25
12	......	1.90	.95	1.28	......	28	1.85	1.05	.88	.88	1.20
13	......	1.90	.95	1.08	......	29	1.90	1.05	.88	.88	1.20
14	......	1.75	.95	.95	......	30	1.95	1.05	.88	.88	1.15
15	......	1.65	.88	.88	......	31	......	1.05	.88	......	1.15
16	1.98	1.55	.88	.88	1.62						

NOTE.—Water turned out October 10 to 15.

COLUMBIA SOUTHERN CANAL NEAR LAIDLAW, OREG.

Columbia Southern canal, which is operated by the Columbia Southern Irrigation Company under provisions of the Carey Act, takes water from Tumalo Creek, 15 miles above its mouth. Measurements are made in the flume 1,000 feet below the head-gate. The gage is set with its zero at the bottom of the flume. It is read by G. W. Updike.

Discharge measurements of Columbia Southern canal near Laidlaw, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
April 19[a]	I. Landes	20	14	....	35
May 15	do	19.7	31.5	1.60	52
June 9	do	19.7	35	1.78	72
June 16	L. R. Allen	19.6	22	1.15	22
June 16	do	19.6	31	1.62	57
June 18	Stevens and Landes	19.7	33	1.65	63

[a] Measured 9 miles below the head of the canal.

Daily gage height, in feet, of Columbia Southern canal near Laidlaw, Oreg., for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	......	1.70	1.87	1.75	1.68	1.70	17	1.70	1.65	2.00	1.70	1.68	1.65
2	......	1.75	1.87	1.75	1.68	1.70	18	1.75	1.65	1.95	1.70	1.68	1.65
3	......	1.75	1.95	1.75	1.68	1.65	19	1.75	1.65	1.95	1.70	1.68	1.65
4	......	1.75	1.95	1.75	1.68	1.65	20	1.75	1.65	1.95	1.70	1.68	1.65
5	......	1.75	1.95	1.75	1.68	1.65	21	1.75	1.70	1.90	1.70	1.68	1.60
6	......	1.70	2.05	1.75	1.68	1.70	22	1.75	1.70	1.90	1.70	1.68	1.60
7	......	1.70	2.05	1.75	1.68	1.70	23	1.75	1.70	1.90	1.70	1.68	1.60
8	......	1.70	2.05	1.75	1.68	1.70	24	1.75	1.70	1.80	1.70	1.68	1.65
9	......	1.70	2.05	1.75	1.68	1.70	25	1.75	1.80	1.80	1.70	1.70	1.65
10	......	1.70	2.10	1.75	1.68	1.72	26	1.75	1.85	1.80	1.70	1.70	1.60
11	......	1.70	2.10	1.75	1.68	1.72	27	1.75	1.80	1.80	1.70	1.70	1.70
12	......	1.70	2.10	1.75	1.68	1.70	28	1.75	1.80	1.80	1.70	1.70	1.65
13	......	1.70	2.10	1.75	1.68	1.70	29	1.70	1.87	1.80	1.70	1.70	1.65
14	......	1.70	2.10	1.75	1.68	1.70	30	1.70	1.87	1.80	1.70	1.70	1.65
15	1.70	1.65	2.00	1.70	1.68	1.70	31	1.70	......	1.80	1.70	......	1.65
16	1.70	1.65	1.88	1.70	1.68	1.70							

Rating table for Columbia Southern canal near Laidlaw, Oreg., for 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.60	55	1.80	74	1.90	86	2.00	99	2.10	114
1.70	64								

NOTE.—The above table is based on 5 discharge measurements made during 1906 and is fairly well defined.

Monthly discharge of Columbia Southern canal near Laidlaw, Oreg., for 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum.	Minimum.	Mean.	
May 15-31	69	64	67.2	2,260
June	82	60	66.6	3,960
July	114	74	91.7	5,640
August	69	64	66.3	4,080
September	64	62	62.4	3,710
October	66	55	61.3	3,770
The period				23,400

NOTE.—Values are rated as good.

SQUAW CREEK NEAR SISTERS, OREG.

The station was established June 15, 1906. It is located 4 miles south of Sisters and above all present diversions. McAllister ditch, under construction, has its intake 200 feet above the station.

The channel is straight for 200 feet above and 100 feet below the station. The right bank is high and rocky; the left is low and liable to overflow at extreme high water. The bed of the stream is of firm gravel and is permanent. Changes in a dam 250 feet below will change the rating.

Measurements are made from a foot log.

Gage heights are furnished jointly by the Squaw Creek Irrigation Company and citizens of Sisters. The gage is vertical, and nailed to an alder tree on the right bank, about 3 feet above the foot log. The bench mark is the highest point of the sawed part of a pine stump 30 feet to the left and 10 feet upstream from the point of measurement; elevation, 10.27 feet above the datum of the gage.

Discharge measurements of Squaw Creek near Sisters, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
April 17	I. Landes	31	48	3.65	106
June 8	L. R. Allen	31	46	3.53	105
June 8	I. Landes	31	49	3.60	114
June 15	J. H. Lewis and L. R. Allen	32	65	4.09	205
September 22	C. W. Allen	31	38	3.55	110

Daily gage height, in feet, of Squaw Creek near Sisters, Oreg., for 1906.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.3	3.75	3.6	3.6	3.1	3.0	17	4.1	3.65	3.25	3.35	2.1	1.7
2	4.2	3.7	3.6	3.65	3.1	1.8	18	4.0	3.65	3.35	3.3	2.0	1.65
3	4.4	3.72	3.5	3.65	3.1	1.6	19	2.25	3.6	3.4	3.3	1.95	1.6
4	4.95	3.7	3.55	3.65	3.1	1.6	20	4.05	3.6	3.45	3.3	1.9	2.3
5	4.6	3.8	3.55	3.3	3.1	1.6	21	4.1	3.5	3.45	3.3	1.8	2.05
6	4.6	4.0	3.75	3.35	3.15	1.6	22	4.2	3.5	3.55	3.3	1.8	2.0
7	4.55	4.0	3.8	3.3	5.25	3.0	23	4.2	3.55	3.4	3.35	1.8	1.9
8	4.5	3.85	4.1	3.35	4.1	1.7	24	3.8	3.55	3.35	3.35	1.8	1.95
9	4.3	3.8	3.6	3.3	3.05	1.75	25	3.85	3.55	3.35	3.35	1.7	2.1
10	4.5	4.0	3.5	3.45	5.7	1.7	26	3.75	3.55	3.3	4.0	1.7	2.0
11	4.55	3.9	3.45	3.4	3.4	1.7	27	4.0	3.6	3.3	3.55	1.7	1.9
12	4.9	4.0	3.45	3.35	3.2	1.75	28	4.2	3.5	3.3	3.35	3.5	1.9
13	4.52	3.95	3.4	3.3	4.2	2.9	29	3.95	3.5	3.4	3.3	3.0	1.8
14	4.4	3.8	3.3	3.3	4.5	1.7	30	3.9	3.6	3.4	3.2	2.05	1.8
15	4.35	3.9	3.3	3.3	3.0	1.7	31	3.85	3.5	......	3.2	......	1.75
16	4.1	3.75	3.25	3.3	2.4	1.75							

Note.—Conditions were changed early in November by washing out of dam below; this was replaced November 28, and washed out again December 3. Ice jam December 1 and 13.

Rating table for Squaw Creek near Sisters, Oreg., from July 1 to October 31, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
3.20	67	3.60	113	4.00	185	4.40	282	4.80	405
3.30	77	3.70	128	4.10	207	4.50	310	4.90	440
3.40	88	3.80	145	4.20	231	4.60	340	5.00	475
3.50	100	3.90	164	4.30	256	4.70	372		

Note.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1906 and it is not well defined.

Monthly discharge of Squaw Creek near Sisters, Oreg., for 1906.

[Drainage area, 90 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
July	458	136	251	15,400	2.79	3.22
August	185	100	133	8,180	1.48	1.71
September	207	72	97.9	5,830	1.09	1.22
October	185	67	88.3	5,400	.981	1.13
The period	....	....	....	34,800	....	....

Note.—Values, July to October, are rated as fair.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Deschutes River drainage basin in 1906:

Miscellaneous measurements in Deschutes River drainage basin, Oregon, in 1906.

Date.	Stream.	Locality.	Width.	Area of section.	Gage height.	Discharge.
			Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
January 9	Crooked River	Forest	50	78	[a]27.43	75
April 16	do	do	135	967	[a]18.71	3,940
May 16	do	do	84	189	[a]25.44	226
June 17	do	do	100	395	[a]23.94	773
October 14	do	do	22	65	[a]24.62	84
April 18[b]	Deschutes Irrigation and Power Company's flume.	Near Bend	14.9	15	....	83
January 10	Deschutes River	Sec. 36, T. 14 S. R. 12 E.	146	481	....	1,350
October 13[c]	do	do	138	458	....	1,230
September 2[d]	do	Moro	260	1,120	1.35	5,040
October 17[d]	do	do	260	1,180	1.40	5,380
October 18	do	Warm Springs Ferry	170	1,600	[e]5.40	4,780
June 8	McAllister ditch	Sisters	7	5	....	6.9
June 15	do	do	7	5.2	....	6.6
October 17	Metolius River	Near mouth	....	....	....	[f]3,800
January 6	Ochoco Creek	Prineville	9	4.4	[g]5.88	4.6
April 16	do	do	71	97	[g]4.55	286
May 17	do	do	14	10	[g]5.76	35
June 7	do	do	44	68	[g]4.87	148
June 13	Pole Creek	Sisters	8	4.2	....	6.2
October 15	Shitike	Warm Springs Agency	26	29	([h])	62
June 10	Swalley canal	Bend, intake flume	7	6	....	13
June 20	do	Bend, below intake flume	13	10	....	12
June 20	do	Bend, 5 miles below head	8	5	....	6.5
October 19	Warm Springs	Warm Springs Agency	92	433	([h])	280
October 20	White River	Tygh Valley	56	56	([h])	166

[a] Below nail in top of floor sill on downstream side of east end of bridge.
[b] Just below headgate; contains discharge of Pilot Butte and Central Oregon canals.
[c] At Tetherow bridge; water surface 4.35 feet below cross cut in northeast corner of bridge on top of abutment.
[d] At Free Bridge gaging station, discontinued December 31, 1899; see Water-Supply Paper No. 38, p. 377, 378.
[e] Below point on alder stump on west bank.
[f] Estimated.
[g] Below reference point on bridge.
[h] Low water.

HOOD RIVER DRAINAGE BASIN.

HOOD RIVER AT WINANS, OREG.

Hood River has its source in the glaciers on the northern slope of Mount Hood, flows north, and unites with Columbia River at the town of Hood River. Its drainage area is wholly mountainous and timbered except where the timber has been removed. A large percentage of its forested area has been burned. The waters of this stream and its tributaries are used for irrigation and power development. The table-lands bordering the river have been cleared of timber and are irrigated by high-line canals. The agricultural products of the district are fruit and berries.

This station was established November 17, 1905. It is located 300 feet below the junction of the main forks of the river at Winans, 10½ miles above Hood River post-office, Oreg. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 219, where are given also references to publications that contain data for previous years.

Discharge measurements of Hood River at Winans, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 17	L. R. Allen	90	147	0.57	493
December 23	do	90	180	1.03	767
1906.					
March 9	P. A. Cupper	99	298	1.90	1,360
May 22 [a]	L. R. Allen	93	188	1.31	702
July 8	do	97	259	1.52	1,160
August 29	do	91	191	.77	571
October 20	J. C. Stevens	95	224	1.17	899
December 15	H. McGlashan	94	253	1.20	864

[a] Not reliable, as débris was lodged against gage.

Daily gage height, in feet, of Hood River at Winans, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.9	1.6	1.8	1.9	2.0	1.3	1.5	1.0	0.7	0.7	1.3	1.1
2	1.0	1.6	1.7	1.8	2.0	1.3	1.5	1.0	.7	.7	1.0	1.2
3	1.0	1.5	1.6	1.7	1.9	1.4	1.6	1.0	.7	.7	.9	1.3
4	1.0	1.5	1.6	1.6	1.9	1.4	1.6	1.0	.7	.7	.9	1.3
5	1.1	1.4	1.5	1.9	1.9	1.4	1.7	1.0	.7	.7	.9	1.4
6	1.2	1.4	1.6	2.0	1.9	1.5	1.7	1.0	.7	.7	.8	1.4
7	1.3	1.3	1.7	2.4	1.9	1.5	1.7	1.0	.7	.7	.8	1.5
8	1.3	1.2	1.9	2.4	1.8	1.6	1.6	1.0	.7	.7	.8	1.5
9	1.4	1.1	1.9	2.2	1.8	1.6	1.5	1.0	.7	.7	.8	1.5
10	1.5	1.1	1.8	2.1	1.8	1.6	1.4	1.0	.7	.7	.9	1.4
11	1.1	1.0	1.6	2.0	1.7	1.6	1.3	1.0	.7	2.0	2.5	1.4
12	1.1	1.0	1.6	1.9	1.7	1.6	1.3	1.0	.7	2.2	4.5	1.3
13	1.1	1.0	1.6	1.9	1.7	1.7	1.3	1.0	.7	2.0	6.4	1.2
14	1.0	1.0	1.6	1.8	1.7	1.8	1.3	1.0	1.2	2.0	6.5	1.2
15	1.0	1.0	1.5	1.8	1.7	1.8	1.3	1.0	1.3	1.9	6.4	1.2
16	1.1	1.0	1.5	1.8	1.6	2.0	1.3	0.9	1.0	1.8	3.7	1.2
17	1.2	1.3	1.5	1.9	1.6	1.9	1.3	.9	.7	1.7	3.4	1.3
18	1.3	3.0	1.6	1.9	1.5	1.7	1.3	.9	.6	1.5	2.7	1.4
19	1.0	3.0	1.6	2.0	1.5	1.7	1.3	.8	.7	1.4	2.4	1.6
20	.9	3.0	1.5	2.1	1.5	1.7	1.3	.8	.7	1.4	2.2	6.6
21	.9	2.9	1.5	2.2	1.5	1.6	1.3	.8	.7	1.4	2.0	4.6
22	1.2	2.8	1.5	2.2	1.4	1.6	1.2	.7	.7	1.4	2.0	3.6
23	1.4	2.4	1.5	2.1	1.4	1.6	1.2	.7	.7	2.0	1.8	3.6
24	2.9	2.3	1.5	2.0	1.4	1.6	1.1	.7	.7	2.0	1.7	3.4
25	2.0	2.2	1.5	2.0	1.5	1.6	1.1	.7	.7	1.9	1.5	3.3
26	1.8	2.2	1.5	2.0	1.5	1.6	1.0	.7	.7	1.8	1.5	3.0
27	1.8	2.0	1.5	2.0	1.5	1.6	.9	.7	.7	1.8	1.4	2.4
28	1.6	1.9	1.5	2.0	1.5	1.6	.9	.7	.7	1.7	1.4	2.2
29	1.7	....	1.6	2.0	1.4	1.6	1.0	.7	.7	1.6	1.2	2.2
30	1.7	....	2.0	2.0	1.4	1.6	1.0	.7	.7	1.5	1.2	2.2
31	1.7	....	2.5	....	1.4	....	1.0	.7	....	1.4	....	2.2

NOTE.—From March to June there was more or less backwater, caused by débris. The flow is influenced by logging dams on the east fork, about 2 miles above the station. These gage heights represent only approximately the daily means.

Rating table for Hood River at Winans, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	430	1.10	835	1.70	1,325	2.30	1,875	2.90	2,460
0.60	490	1.20	910	1.80	1,415	2.40	1,970	3.00	2,560
0.70	555	1.30	990	1.90	1,505	2.50	2,065	4.00	3,560
0.80	620	1.40	1.070	2.00	1,595	2.60	2,160	5.00	4,660
0.90	690	1.50	1.155	2.10	1,685	2.70	2,260	6.00	5,860
1.00	760	1.60	1,240	2.20	1,780	2.80	2,360		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1905–6 and is well defined between gage heights 0.5 foot and 1.5 feet. Above gage height 2.0 feet it becomes uncertain, and for the highest stages is only approximate.

Monthly discharge of Hood River at Winans, Oreg., for 1905–6.

[Drainage area, 370 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
November 19–30	1,160	555	709	16,900	1.92	.857
December	1,420	555	804	49,400	2.17	2.50
The period				66,300		
1906.						
January	2,460	690	1,030	63,300	2.78	3.20
February	2,560	700	1,400	77,800	3.78	3.94
March	2,060	1,150	1,280	78,700	3.46	3.99
April	1,970	1,240	1,590	94,600	4.30	4.80
May	1,600	1,070	1,280	78,700	3.46	3.99
June	1,600	990	1,240	73,800	3.35	3.74
July	1,320	690	1,000	61,500	2.70	3.11
August	700	555	674	41,400	1.82	2.10
September	990	490	586	34,900	1.58	1.76
October	1,780	555	1,100	67,600	2.97	3.42
November	6,460	620	1,890	112,000	5.11	5.70
December	6,580	835	1,740	107,000	4.70	5.42
The year	6,580	490	1,230	891,000	3.33	45.17

Note.—Values are rated as follows: March to June, 1906, approximate; remainder of 1905 and 1906, good. Débris caused backwater to a greater or less extent.

WILLAMETTE RIVER DRAINAGE BASIN.

DESCRIPTION OF BASIN.

Willamette River is formed by the junction of Middle and Coast forks near Eugene, Oreg., from which point it flows in a general northerly direction to its point of junction with the Columbia, about 10 miles north of Portland. Coast Fork rises in the eastern slope of the Coast Range and Middle Fork on the western slope of the Cascade Mountains. The tributaries of this stream flow both east and west, draining heavily timbered mountain areas. Many of them afford extensive power possibilities. At present the development in this line is in the primitive state. The natural resources of the Willamette Valley would make it an unrivaled manufacturing center. There is unlimited water power, an abundance of raw material, and adequate transportation facilities. The principal tributaries of this stream are the McKenzie, Santiam, Luckiamute, Molalla, Yamhill, and Clackamas rivers.

WILLAMETTE RIVER AT ALBANY, OREG.

This station was established July 21, 1905. It is located at the Corvallis and Eastern Railroad bridge at Albany, Oreg., just above the mouth of Calipooia Creek and 7 miles above the mouth of Santiam River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 223.

Discharge measurements of Willamette River at Albany, Oreg., in 1905–1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1905.					
July 20	L. R. Allen	....	3,720	3.29	3,430
1906.					
January 5	L. R. Allen	438	5,160	6.56	13,400
February 8	do	439	4,860	5.84	11,700
March 28	do	438	4,900	6.12	13,300
May 9	do	433	4,380	5.10	9,380
July 25	do	428	3,610	2.92	4,360
September 5	I. E. Oakes	425	3,580	2.20	2,960
1907.					
February 5	I. E. Oakes	2,960	38,500	27.55	146,000

Daily gage height, in feet, of Willamette River at Albany, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	9.3	7.5	12.7	7.9	6.05	7.8	4.45	2.8	2.4	2.35	3.1	5.05
2	8.8	7.45	10.5	8.3	5.85	6.9	4.25	2.75	2.35	2.3	2.95	4.8
3	7.4	7.15	9.4	7.55	5.75	6.5	4.2	2.7	2.3	2.3	2.9	4.65
4	6.8	7.05	8.7	6.98	5.55	6.3	4.1	2.7	2.3	2.35	2.95	4.4
5	6.75	6.75	8.25	6.68	5.5	6.8	3.95	2.7	2.2	2.4	3.15	4.5
6	6.55	6.55	7.75	6.48	5.4	6.55	3.8	2.5	2.2	2.4	3.35	4.5
7	6.5	6.2	7.5	6.28	5.25	6.7	3.75	2.6	2.2	2.4	3.9	4.7
8	6.4	5.8	7.5	6.18	5.05	7.1	3.7	2.6	2.2	2.4	6.9	5.5
9	6.75	5.75	7.5	6.08	5.1	6.9	3.7	2.5	2.2	2.3	9.3	6.5
10	8.3	5.6	7.45	6.3	5.0	7.3	3.55	2.6	2.2	2.3	7.5	7.1
11	8.1	5.5	7.4	6.05	5.1	7.2	3.3	2.6	2.1	2.35	7.2	7.5
12	8.3	5.35	7.25	5.8	5.1	6.9	3.3	2.6	2.15	2.4	7.1	7.55
13	9.0	5.2	6.7	5.55	5.0	6.65	3.3	2.55	2.2	2.45	6.9	6.8
14	10.25	5.1	6.4	5.35	4.9	6.5	3.25	2.5	2.3	2.65	8.4	6.45
15	10.2	4.85	6.15	5.25	5.0	6.3	3.2	2.5	2.3	2.7	10.95	6.2
16	10.3	5.05	5.75	5.25	5.7	6.5	3.2	2.5	2.5	2.9	12.35	6.65
17	13.0	5.15	5.55	5.3	5.75	7.4	3.1	2.5	2.8	3.45	13.1	8.15
18	15.0	5.75	5.38	5.2	5.4	7.05	3.1	2.5	2.9	4.6	12.9	7.35
19	13.0	7.05	5.32	5.08	5.2	6.6	3.1	2.5	2.75	4.65	13.05	7.3
20	11.8	9.85	5.42	4.92	5.1	6.5	3.1	2.5	2.65	4.3	10.7	8.8
21	9.8	11.6	5.72	5.42	5.1	5.8	3.1	2.6	2.6	4.05	9.35	11.4
22	8.85	13.25	6.2	5.25	5.35	5.55	3.0	2.5	2.4	3.7	9.25	10.95
23	8.15	12.55	6.32	5.4	5.8	5.3	3.0	2.5	2.4	3.4	8.9	9.8
24	9.6	12.85	6.25	5.22	5.9	5.1	3.0	2.65	2.5	3.25	8.0	9.85
25	10.6	14.8	6.18	5.5	5.7	4.9	2.9	2.8	2.5	3.2	7.1	9.45
26	10.25	15.1	6.08	5.68	5.6	4.6	2.9	2.95	2.5	3.1	6.55	10.65
27	9.4	13.9	6.1	5.95	5.6	4.5	2.85	2.75	2.55	2.9	6.2	11.45
28	8.55	13.5	6.22	5.9	5.55	4.5	2.8	2.6	2.5	3.3	5.85	10.5
29	8.1	....	6.42	6.4	7.2	4.55	2.8	2.5	2.5	3.25	5.55	9.4
30	7.65	....	5.8	6.25	9.95	4.55	2.8	2.5	2.4	3.15	5.25	8.5
31	7.5	....	6.1	....	8.9	....	2.8	2.4	....	3.1	....	8.4

Rating tables for Willamette River at Albany, Oreg.

1905.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	1,755	2.90	2,835	3.80	4,320	4.70	6,260	6.20	10,300
2.10	1,855	3.00	2,980	3.90	4,510	4.80	6,500	6.40	10,910
2.20	1,960	3.10	3,130	4.00	4,710	4.90	6,750	6.60	11,530
2.30	2,070	3.20	3,385	4.10	4,910	5.00	7,000	6.80	12,160
2.40	2,185	3.30	3,445	4.20	5,120	5.20	7,500	7.00	12,800
2.50	2,305	3.40	3,610	4.30	5,340	5.40	8,020	8.00	15,000
2.60	2,430	3.50	3,780	4.40	5,560	5.60	8,560	9.00	19,400
2.70	2,560	3.60	3,955	4.50	5,790	5.80	9,120		
2.80	2,695	3.70	4,135	4.60	6,020	6.00	9,700		

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[a] This table is applicable only for open-channel conditions. It is based on one discharge measurement made during 1905 and the form of the 1906 curve and is not well defined.

Rating tables for Willamette River at Albany, Oreg.—Continued.

1906.[a]

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.00	2,670	3.10	4,730	4.20	7,240	5.60	11,010	7.80	18,060
2.10	2,810	3.20	4,950	4.30	7,480	5.80	11,600	8.00	18,800
2.20	2,960	3.30	5,170	4.40	7,730	6.00	12,200	9.00	22,700
2.30	3,120	3.40	5,390	4.50	7,980	6.20	12,800	10.00	27,000
2.40	3,290	3.50	5,610	4.60	8,230	6.40	13,410	11.00	31,600
2.50	3,470	3.60	5,840	4.70	8,490	6.60	14,030	12.00	36,400
2.60	3,660	3.70	6,070	4.80	8,760	6.80	14,660	13.00	41,300
2.70	3,860	3.80	6,300	4.90	9,030	7.00	15,300	14.00	46,700
2.80	4,070	3.90	6,530	5.00	9,300	7.20	15,960	15.00	52,200
2.90	4,290	4.00	6,760	5.20	9,860	7.40	16,640		
3.00	4,510	4.10	7,000	5.40	10,430	7.60	17,340		

[a] This table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1906 and 1 during 1907 and is well defined between gage heights 2.2 feet and 6.5 feet.

Monthly discharge of Willamette River at Albany, Oreg., for 1905–6.

[Drainage area, 4,860 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
September	2,560	1,800	2,020	120,000	0.416	0.46
October[a]	6,750	2,700	3,750	231,000	.772	.89
November[a]	5,900	2,430	3,450	205,000	.710	.79
December	18,700	4,910	9,650	593,000	1.99	2.29
The period				1,150,000		
1906.						
January	52,200	13,400	23,600	1,450,000	4.86	5.60
February	52,800	8,900	21,900	1,220,000	4.51	4.70
March	39,800	10,200	15,700	965,000	3.23	3.72
April	19,900	9,080	12,200	726,000	2.51	2.80
May	26,800	9,030	11,500	707,000	2.37	2.73
June	18,100	7,980	12,900	768,000	2.65	2.96
July	7,860	4,070	5,260	323,000	1.08	1.24
August	4,400	3,290	3,680	226,000	.757	.87
September	4,290	2,810	3,320	198,000	.683	.76
October	8,360	3,120	4,530	279,000	.932	1.07
November	41,800	4,290	18,200	1,080,000	3.74	4.17
December	33,800	7,730	18,200	1,120,000	3.74	4.31
The year	52,800	2,810	12,600	9,060,000	2.59	34.93

[a] Gage heights published in Water-Supply Paper No. 178 as 2.11 feet should be 2.9 feet, 3.11 should be 3.9, and 2.1 should be 2.8.

NOTE.—Values are rated as follows: September, 1905, to February, 1906, fair; March to December, 1906, good.

MIDDLE FORK OF WILLAMETTE RIVER AT JASPER, OREG.

This station was established September 16, 1905. It is located at Jasper Ferry, Jasper post-office, Oreg., 2 miles above Natron and 3 miles below the mouth of Fall Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 220.

Discharge measurements of Middle Fork of Willamette River at Jasper, Oreg., in 1905–1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1905.					
September 16	L. R. Allen	322	652	1.25	758
December 29	do	354	1,370	3.27	3,920
1906.					
February 3	L. R. Allen	368	1,590	3.87	5,530
March 23	do	357	1,400	[a]3.38	3,890
May 5	do	356	1,420	[a]3.52	5,290
August 17	do	325	726	1.48	953
September 17	I. E. Oakes	327	807	1.70	1,130
1907.					
January 30	do	396	2,730	7.10	21,100

[a] Affected by log jam.

Daily gage height, in feet, of Middle Fork of Willamette River at Jasper, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	3.8	4.4	4.6	3.6	4.0	2.6	1.7	1.4	1.4	1.6	2.5
2	3.1	3.8	4.1	4.2	3.5	3.9	2.6	1.7	1.4	1.4	1.6	2.5
3	3.1	3.9	4.0	4.1	3.5	3.8	2.5	1.6	1.4	1.5	1.6	2.4
4	3.1	3.7	3.9	3.8	3.4	4.1	2.5	1.6	1.4	1.9	1.6	2.3
5	3.0	3.6	3.7	3.7	3.4	4.0	2.5	1.7	1.4	1.5	2.0	2.4
6	3.2	3.6	3.7	3.6	3.3	4.1	2.4	1.6	1.4	1.5	2.0	2.7
7	3.2	3.4	3.8	3.6	3.3	4.4	2.3	2.0	1.4	1.5	3.3	2.7
8	3.3	3.3	3.9	3.5	3.2	4.3	2.2	1.8	1.4	1.4	4.6	3.6
9	4.6	3.2	4.0	3.7	3.2	4.4	2.1	2.0	1.5	1.4	3.7	3.6
10	4.3	3.1	4.1	3.6	3.4	4.5	2.1	2.2	1.5	1.4	3.2	3.6
11	4.0	3.0	3.9	3.4	3.5	4.2	2.0	2.2	1.4	1.4	3.7	3.7
12	4.2	2.9	3.7	3.2	3.3	4.1	2.0	2.3	1.5	1.5	3.2	3.5
13	4.5	2.8	3.5	3.2	3.2	4.0	2.0	2.0	2.2	1.7	4.1	3.2
14	4.2	2.8	3.3	3.1	3.1	3.8	1.9	2.2	1.9	1.6	4.9	3.1
15	4.1	2.8	3.2	3.0	3.6	3.7	1.9	1.5	2.4	1.6	5.6	3.0
16	6.3	2.9	3.0	3.0	3.4	4.4	1.9	1.5	2.0	2.2	6.1	4.4
17	5.9	3.1	2.9	3.1	3.2	4.2	2.0	1.5	1.7	2.9	5.9	4.0
18	4.9	3.4	2.8	3.0	3.0	3.9	1.8	1.5	1.6	2.7	6.0	3.7
19	4.2	5.1	2.8	2.9	2.9	3.6	1.8	1.5	1.5	2.6	4.8	4.4
20	4.0	5.05	2.8	2.9	2.9	3.5	1.8	1.5	1.5	2.2	4.2	5.7
21	3.5	5.4	3.0	2.9	3.2	3.3	1.7	1.4	1.5	2.1	4.5	5.3
22	3.4	5.1	3.2	3.0	3.4	3.7	1.6	1.4	1.4	1.9	4.3	4.6
23	4.0	4.8	3.2	3.1	3.6	3.1	1.7	1.4	1.5	1.8	4.0	4.3
24	5.2	5.5	3.3	3.4	3.4	3.1	1.7	1.4	1.5	1.7	3.6	4.2
25	5.0	5.5	3.4	3.4	3.4	2.8	1.7	1.4	1.6	1.7	3.3	4.5
26	4.8	4.9	3.5	3.6	3.3	2.8	1.8	1.4	1.6	1.6	3.2	5.3
27	4.7	5.0	3.4	3.4	3.3	2.8	1.7	1.3	1.5	2.1	3.0	4.8
28	4.2	4.7	3.3	3.8	4.2	2.9	1.7	1.4	1.5	1.9	2.8	4.3
29	4.0		3.3	3.7	5.7	2.8	1.6	1.4	1.4	1.7	2.8	4.0
30	3.9		3.3	3.6	5.1	2.7	1.6	1.4	1.4	1.7	2.6	4.0
31	3.8		4.1		4.6		1.6	1.4		1.6		4.0

NOTE.—From June to August the discharge showed considerable daily fluctuation, caused by storage at logging dams. There was also some backwater from log jams during the same period, especially August 7 to 14.

Rating table for Middle Fork of Willamette River at Jasper, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.20	730	2.20	1,790	3.20	3,750	4.20	6,690	5.40	11,670
1.30	800	2.30	1,940	3.30	3,990	4.30	7,050	5.60	12,650
1.40	880	2.40	2,110	3.40	4,240	4.40	7,420	5.80	13,680
1.50	960	2.50	2,290	3.50	4,500	4.50	7,800	6.00	14,750
1.60	1,050	2.60	2,480	3.60	4,780	4.60	8,190	6.20	15,860
1.70	1,150	2.70	2,670	3.70	5,070	4.70	8,590	6.40	16,990
1.80	1,260	2.80	2,870	3.80	5,370	4.80	9,000	6.60	18,150
1.90	1,380	2.90	3,080	3.90	5,[illegible]0	4.90	9,420	6.80	19,320
2.00	1,510	3.00	3,300	4.00	6,000	5.00	9,850	7.00	20,500
2.10	1,650	3.10	3,520	4.10	6,340	5.20	10,740		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 6 discharge measurements made during 1905–1907 and is fairly well defined.

Monthly discharge of Middle Fork of Willamette River at Jasper, Oreg., for 1905–6.

[Drainage area, 1,450 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
September 16–30	1,380	730	868	25,800	0.599	0.33
October	3,520	880	1,580	97,200	1.09	1.26
November	3,520	880	1,430	85,100	.986	1.10
December	6,340	1,790	3,360	207,000	2.32	2.68
The period	6,340	1,790	....	415,000	....	....
1906.						
January	16,400	3,300	6,720	413,000	4.63	5.34
February	12,200	2,870	6,290	349,000	4.34	4.52
March	7,420	2,870	4,610	283,000	3 18	3.67
April	8,190	3,080	4,430	264,000	3.06	3.41
May	13,200	3,080	4,760	293,000	3.28	3.78
June	7,800	2,670	5,240	312,000	3.61	4.03
July	2,480	1,050	1,530	94,100	1.06	1.22
August [a]	1,150	800	969	59,600	.668	.77
September	2,110	880	1,040	61,900	.717	.80
October	3,080	880	1,310	80,600	.903	1.04
November	15,300	1,050	5,710	340,000	3.94	4.40
December	13,200	1,940	5,670	349,000	3.91	4.51
The year	16,400	800	4,020	2,900,000	2.77	37.49

[a] August 7 to 14, discharge estimated at 1,000 second-feet.

NOTE.—Values are rated as follows: September, 1905, to February, 1906, and September to December, 1906, excellent; March, April, July, and August, good; May and June, fair.

COAST FORK OF WILLAMETTE RIVER NEAR GOSHEN, OREG.

This station was established August 23, 1905. It is located at the highway bridge 3 miles east of Goshen, Oreg., 9 miles southeast of Eugene, and about 4 miles above the junction of Coast and Middle forks of Willamette River. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 221.

Discharge measurements of Coast Fork of Willamette River near Goshen, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 23	L. R. Allen	80	47	0.30	67.6
November 7	do	165	204	.67	182
December 29	do	241	677	2.78	1,910
1906.					
February 2	L. R. Allen	242	570	2.38	1,620
March 22	do	243	697	2.87	2,290
May 3	do	234	402	1.70	917
July 16	do	160	226	.82	252
August 17	do	145	158	.58	132
September 19	I. E. Oakes	154	168	.65	145
1907.					
January 31	I. E. Oakes	256	1,870	7.75	10,700

Daily gage height, in feet, of Coast Fork of Willamette River near Goshen, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	2.5	4.3	4.7	2.0	3.4	1.3	0.6	0.3	0.7	0.8	1.4
2	3.0	2.5	3.7	3.7	1.8	2.9	1.3	.6	.3	.7	.8	1.4
3	2.8	2.0	3.3	3.2	1.7	2.8	1.2	.6	.3	.6	.8	1.5
4	2.8	2.0	3.2	3.0	1.5	3.0	1.2	.6	.3	.5	1.0	1.5
5	3.1	2.0	3.0	2.7	1.5	2.7	1.3	.6	.3	.7	1.5	1.7
6	3.0	1.8	3.0	2.6	1.5	2.6	1.1	.6	.3	.7	1.6	1.8
7	2.7	1.8	2.9	2.5	1.5	2.7	1.1	.5	.3	.5	1.9	2.3
8	2.5	1.7	2.9	2.2	1.4	2.9	1.1	.5	.3	.5	2.0	2.9
9	5.0	1.6	2.8	2.3	1.4	3.5	1.1	.5	.3	.5	2.5	3.0
10	4.0	1.6	2.7	2.2	1.4	3.0	1.0	.5	.3	.6	2.0	3.4
11	3.6	1.6	2.5	2.0	1.4	2.7	1.0	.5	.3	.6	2.0	3.0
12	3.5	1.5	2.3	1.9	1.3	2.5	1.0	.5	.5	.8	2.0	2.7
13	5.4	1.3	2.1	1.7	1.3	2.5	1.0	.5	.5	1.0	2.0	2.3
14	4.5	1.3	2.0	1.7	1.4	2.3	.9	.4	.8	1.0	3.0	2.3
15	4.3	1.7	1.9	1.6	2.2	2.3	.9	.4	1.0	1.0	3.4	2.1
16	5.7	1.4	1.8	1.5	2.5	2.3	.8	.4	1.0	1.2	5.2	4.0
17	7.5	1.6	1.6	1.5	2.2	2.9	.8	.5	.8	1.5	4.3	3.7
18	5.4	2.0	1.7	1.5	2.0	2.6	.8	.5	.8	1.9	5.0	3.0
19	4.5	4.5	1.7	1.4	2.0	2.3	.8	.5	.7	1.8	4.7	3.2
20	3.7	3.7	1.9	1.4	2.0	2.0	.8	.5	.5	1.7	3.0	4.4
21	3.3	6.2	2.7	1.4	1.9	2.0	.8	.5	.5	1.5	3.6	4.0
22	3.0	5.6	2.9	1.5	2.4	1.8	.8	.5	.5	1.4	3.0	3.0
23	3.5	5.2	2.6	1.6	2.9	1.5	.8	.5	.6	1.4	3.0	3.0
24	5.4	7.0	2.5	1.6	2.5	1.6	.8	.5	.7	1.0	2.6	3.4
25	4.4	7.0	2.4	1.7	2.3	1.6	.8	.4	1.0	1.0	2.3	4.0
26	3.7	5.3	2.2	2.0	2.3	1.5	.7	.3	.8	1.0	2.0	5.0
27	3.5	6.0	2.2	1.9	2.1	1.5	.7	.3	.7	1.0	2.0	4.2
28	3.5	5.0	2.1	2.7	2.5	1.5	.7	.3	.6	.9	2.0	3.3
29	2.7	....	2.0	2.7	9.5	1.5	.7	.3	.6	.9	1.7	2.6
30	2.7	....	2.0	2.2	5.7	1.4	.7	.3	....	.9	1.5	2.6
31	2.6	....	3.0	....	4.4	....	.7	.3	....	.8	....	2.3

Rating table for Coast Fork of Willamette River near Goshen, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	52	1.40	635	2.60	1,880	3.80	3,610	6.00	7,670
0.30	68	1.50	720	2.70	2,005	3.90	3,775	6.20	8,070
0.40	89	1.60	810	2.80	2,135	4.00	3,940	6.40	8,470
0.50	115	1.70	905	2.90	2,270	4.20	4,280	6.60	8,870
0.60	147	1.80	1,005	3.00	2,410	4.40	4,625	6.80	9,270
0.70	186	1.90	1,105	3.10	2,550	4.60	4,980	7.00	9,670
0.80	232	2.00	1,210	3.20	2,695	4.80	5,350	8.00	11,750
0.90	285	2.10	1,315	3.30	2,840	5.00	5,720	9.00	13,850
1.00	345	2.20	1,420	3.40	2,990	5.20	6,100	10.00	16,050
1.10	410	2.30	1,530	3.50	3,140	5.40	6,485		
1.20	480	2.40	1,645	3.60	3,295	5.60	6,875		
1.30	555	2.50	1,760	3.70	3,450	5.80	7,270		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 9 discharge measurements made during 1905–1907 and is well defined between gage heights 0.3 foot and 3.0 feet.

Monthly discharge of Coast Fork of Willamette River near Goshen, Oreg., for 1905-6.

[Drainage area, 690 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft per sq. mile.	Depth in inches.
1905.[a]						
August 23-31	68	58	64.7	1,150	0.094	0.031
September 1-20	58	52	56.5	2,240	.082	.061
October 4-31	1,530	115	492	27,300	.713	.742
November	2,410	68	483	28,700	.701	.782
December	5,720	555	1,870	115,000	2.71	3.12
The period				174,000		
1906.[b]						
January	10,700	1,760	3,820	235,000	5.54	6.39
February	9,670	555	3,080	171,000	4.46	4.64
March	4,450	810	1,790	110,000	2.59	2.99
April	5,160	635	1,460	86,900	2.12	2.36
May	15,000	555	1,870	115,000	2.71	3.12
June	3,140	635	1,620	96,400	2.35	2.62
July	555	186	311	19,100	.451	.520
August	147	68	109	6,700	.158	.182
September	345	68	147	8,750	.213	.238
October	1,100	115	373	22,900	.541	.62
November	6,100	232	1,920	114,000	2.78	3.10
December	5,720	635	2,410	148,000	3.49	4.02
The year	15,000	68	1,580	1,130,000	2.28	30.80

[a] Values for 1905 are rated as follows: August to November, good; December, fair.
[b] Values for 1906 are rated as excellent.

M'KENZIE RIVER NEAR SPRINGFIELD, OREG.

This station was established September 12, 1905, by L. R. Allen. It is located at Hendricks Ferry, 11 miles above Springfield, about 3 miles above the mouth of Camp Creek. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 222.

Discharge measurements of McKenzie River near Springfield, Oreg., in 1905-6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 12	L. R. Allen	395	928	1.30	1,570
November 10	do	398	880	1.12	1,810
December 30	do	404	1,370	2.65	4,900
1906.					
February 5	L. R. Allen	372	1,400	2.66	5,280
March 24	do	342	1,190	2.14	3,690
May 4	do	384	1,400	2.71	5,040
June 7	do	379	1,430	[a] 2.77	5,160
July 26	do	327	1,100	[a] 1.40	2,250
August 15	do	328	1,110	[a] 1.40	1,960
September 18	I. E. Oakes	315	924	1.05	1,860

[a] Affected by log jam.

Daily gage height, in feet, of McKenzie River near Springfield, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	3.1	3.3	3.55	2.75	2.85	1.9	1.4	1.4	1.0	1.3	2.1
2	2.2	3.0	3.1	2.85	2.65	2.75	1.85	1.4	1.4	1.15	1.3	2.0
3	2.1	2.9	3.0	2.7	2.65	2.7	1.8	1.4	1.4	1.15	1.3	1.9
4	2.2	2.75	2.85	2.65	2.7	2.7	1.8	1.4	1.4	1.1	1.4	1.95
5	2.3	2.55	2.8	2.5	2.5	2.8	1.75	1.4	1.4	1.1	1.5	2.0
6	2.45	2.5	2.9	2.75	2.6	3.0	1.75	1.4	1.4	1.1	1.55	2.05
7	2.5	2.4	3.0	2.8	2.5	3.25	1.7	1.4	1.4	1.05	1.35	3.1
8	2.5	2.3	3.3	2.9	2.5	3.15	1.7	1.4	1.4	1.05	4.6	2.95
9	3.2	2.2	3.2	3.0	2.5	3.4	1.65	1.4	1.4	1.0	3.2	2.75
10	2.8	2.1	3.15	2.85	2.5	3.2	1.7	1.4	1.4	1.0	3.7	2.7
11	3.0	2.1	2.85	2.7	2.45	3.05	1.8	1.4	1.4	1.0	4.4	2.5
12	3.1	2.05	2.7	2.5	2.35	2.8	1.85	1.4	1.5	1.3	3.0	3.1
13	3.3	2.0	2.5	2.55	2.25	2.7	1.95	1.4	1.8	1.15	5.5	3.2
14	3.05	2.0	2.4	2.55	2.7	3.1	2.05	1.45	2.15	1.25	6.5	3.2
15	2.85	2.1	2.3	2.7	2.6	3.45	2.0	1.4	2.25	1.3	6.5	2.95
16	4.25	2.15	2.2	2.75	2.55	3.4	2.05	1.4	1.8	1.95	6.2	2.9
17	3.7	2.4	2.15	2.8	2.45	3.1	1.5	1.4	1.2	2.6	5.35	2.9
18	3.5	3.0	2.1	2.75	2.4	2.95	1.4	1.4	1.1	2.3	4.3	2.8
19	3.2	3.95	2.0	2.7	2.35	2.8	1.4	1.4	1.05	2.2	4.1	2.75
20	2.95	4.5	2.0	2.35	2.35	2.45	1.45	1.4	1.25	1.9	4.0	4.0
21	2.5	4.2	2.1	2.5	2.55	2.3	1.45	1.4	1.2	1.5	3.9	6.0
22	2.95	4.05	2.1	2.55	2.5	2.2	1.5	1.4	1.15	1.45	3.6	4.9
23	4.9	4.1	2.0	2.85	2.55	2.15	1.45	1.4	1.1	1.4	3.3	4.85
24	4.45	4.3	2.15	3.0	2.5	2.1	1.45	1.4	1.1	1.4	3.2	4.65
25	4.2	4.05	2.24	3.15	2.5	2.05	1.45	1.4	1.1	1.35	2.9	4.4
26	3.5	3.9	2.5	2.9	2.55	2.0	1.45	1.4	1.05	1.7	2.5	4.15
27	3.35	3.6	2.55	2.85	2.45	2.0	1.45	1.4	1.05	2.0	2.55	3.9
28	3.2	3.45	2.5	2.9	3.7	2.05	1.4	1.4	1.05	1.7	2.45	3.65
29	3.0	......	2.5	2.8	3.65	2.0	1.4	1.4	1.0	1.8	2.3	3.45
30	3.15	......	2.8	2.75	3.45	1.95	1.4	1.4	1.0	1.6	2.2	3.2
31	3.3	......	3.5	......	3.0	......	1.4	1.4	......	1.8	......	2.95

Rating table for McKenzie River near Springfield, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	1,630	1.80	3,000	2.60	4,760	3.40	5,920	4.40	10,000
1.10	1,780	1.90	3,200	2.70	5,010	5.50	7,210	4.60	10,770
1.20	1,930	2.00	3,410	2.80	5,270	3.60	7,510	4.80	11,450
1.30	2,090	2.10	3,620	2.90	5,530	3.70	7,820	5.00	12,150
1.40	2,260	2.20	3,840	3.00	5,800	3.80	8,130	6.00	15,650
1.50	2,440	2.30	4,060	3.10	6,070	3.90	8,450	7.00	19,250
1.60	2,620	2.40	4,290	3.20	5,350	4.00	8,770		
1.70	2,810	2.50	4,520	3.30	5,630	4.20	9,420		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1905-6 and is fairly well defined between gage heights 1 foot and 3 feet.

Monthly discharge of McKenzie River near Springfield, Oreg., for 1905–6.

[Drainage area, 960 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.[a]						
September 12–30	2,810	2,090	2,230	84,000	2.32	1.64
October	5,270	2,090	2,770	170,000	2.89	3.33
November	4,060	1,780	2,260	134,000	2.35	2.62
December	6,920	2,810	4,010	247,000	4.18	4.82
The period	....	....	....	635,000	....	....
1906.[b]						
January	11,800	3,620	6,200	381,000	6.46	7.45
February	10,800	3,410	5,980	332,000	6.23	6.49
March	7,210	3,410	4,850	298,000	5.05	5.82
April	7,360	4,170	5,220	311,000	5.44	6.07
May	7,820	3,950	4,900	301,000	5.10	5.88
June	7,060	3,300	5,040	300,000	5.25	5.86
July	3,510	2,260	2,710	167,000	2.82	3.25
August	2,350	2,260	2,260	139,000	2.35	2.71
September[c]	3,950	1,630	2,200	131,000	2.29	2.56
October	4,760	1,630	2,440	150,000	2.54	2.93
November	17,400	2,090	7,300	434,000	7.60	8.48
December	15,600	3,200	6,650	409,000	6.93	7.99
The period	17,400	1,630	4,650	3,350,000	4.84	65.49

[a] Values for 1905 are rated as follows: November and December, excellent; October, fair; September, approximate.

[b] Values are rated as follows: January to July, good; August to December, fair.

[c] During the morning of September 17, 1906, there was a drop of 0.5 foot in the water due to the removal of a log jam lodged on a bar 200 yards below the gage. The daily discharge September 12 to 17 was applied as if open-channel conditions existed. It is impossible to judge accurately the extent of the backwater effect from this log jam owing to a natural rise from rains about the middle of September, but the monthly mean for this month is believed to be not more than 2 or 3 per cent too high from this cause. Estimates for this station are affected by log drives which cause changes in the channel and modify the flow generally.

NORTH FORK OF SANTIAM RIVER AT MEHAMA, OREG.

This station was established July 11, 1905. It is located just below the highway bridge at Mehama, Oreg., about 1½ miles north of Lyons, the nearest railroad station, which is about 12 miles below the junction of Little North Fork and North Fork. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 224.

Discharge measurements of North Fork of Santiam River at Mehama, Oreg., in 1905–1907.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Dis-charge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 11	L. R. Allen	160	756	2.90	1,050
October 18[a]	do	202	1,010	4.44	3,580
November 16	J. H. Lewis	155	756	2.90	973
December 12	L. R. Allen	250	927	4.24	2,880
1906.					
January 4[a]	L. R. Allen	249	926	4.20	2,230
February 7	do	251	1,000	4.51	3,320
March 26	do	250	927	4.20	2,740
May 7	do	250	947	4.28	2,800
May 15[b]	do	253	1,030	4.65	3,060
July 17	do	242	632	3.04	1,080
August 21	do	237	550	2.64	756
September 27	I. E. Oakes	242	585	2.83	905
1907.					
February 6	I. E. Oakes	305	2,710	11.00	29,100

[a] Measurement unreliable. [b] Backwater from log jam.

Daily gage height, in feet, of North Fork of Santiam River at Mehama, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.35	5.8	5.5	5.45	5.0	4.3	3.8	2.3	2.6	2.7	3.3	3.75
2	4.2	5.9	5.8	5.0	4.6	4.1	3.8	2.3	2.55	2.8	3.25	3.7
3	4.1	5.5	5.2	4.7	4.6	4.2	3.7	2.3	2.55	3.55	3.2	3.7
4	4.2	5.2	5.15	4.55	4.6	4.8	3.65	2.75	2.55	3.6	3.45	3.5
5	4.4	5.0	5.0	4.55	4.6	4.5	3.6	2.75	2.55	3.3	3.8	3.75
6	4.5	4.75	5.25	4.3	4.3	5.0	3.5	2.75	2.55	3.1	3.7	4.0
7	4.5	4.6	5.4	5.0	4.3	5.4	3.4	2.75	2.55	2.95	9.65	6.2
8	4.6	4.4	5.6	5.0	4.3	5.1	3.35	2.75	2.55	2.9	10.0	5.5
9	5.1	4.25	5.5	5.3	4.5	5.1	3.3	2.75	2.65	2.8	6.9	5.2
10	4.85	4.15	5.65	5.0	4.6	5.1	3.25	2.7	2.65	2.8	8.5	4.8
11	5.5	4.05	5.2	5.0	5.0	4.7	3.25	2.7	2.6	2.8	6.5	4.85
12	5.0	4.0	4.9	5.0	4.45	4.8	3.2	2.7	2.7	3.25	6.75	4.6
13	5.3	3.9	4.7	4.85	4.25	4.7	3.2	2.7	3.15	3.3	11.25	4.5
14	5.0	3.9	4.4	4.8	4.4	4.4	3.2	2.7	4.1	3.0	12.35	4.2
15	4.7	4.2	4.2	4.5	5.0	4.5	3.15	2.7	4.2	3.3	11.7	4.5
16	5.3	4.3	4.1	4.6	4.2	5.4	3.1	2.7	3.1	5.1	8.3	7.3
17	5.3	4.9	3.9	4.6	4.05	5.0	3.1	2.7	3.05	5.3	9.1	5.4
18	5.15	6.2	3.95	4.3	4.05	4.75	3.0	2.7	2.9	5.2	8.65	5.0
19	4.8	7.7	3.9	4.3	4.25	4.5	3.0	2.65	2.9	4.75	6.6	5.4
20	4.5	8.1	3.3	4.3	4.2	4.35	3.0	2.65	2.8	4.35	5.9	10.6
21	4.35	7.85	3.3	4.9	4.5	4.2	2.95	2.65	2.75	3.9	6.05	9.6
22	4.5	7.05	3.8	4.7	4.5	4.2	2.95	2.65	2.7	3.7	5.5	7.2
23	6.3	6.85	3.7	4.6	4.5	3.9	2.95	2.6	2.7	3.5	5.1	6.4
24	8.55	6.4	3.95	4.5	4.3	3.9	2.9	2.6	2.95	3.4	4.9	6.4
25	6.8	6.05	3.05	5.2	4.2	3.8	2.9	2.6	3.15	3.4	4.6	6.6
26	6.25	6.4	4.2	5.2	4.3	3.75	2.85	2.6	2.9	4.2	4.4	6.6
27	5.85	6.6	4.3	4.95	4.2	3.65	2.85	2.6	2.8	4.3	4.3	6.3
28	5.5	5.95	4.25	5.2	4.1	3.65	2.85	2.6	2.8	3.85	4.0	5.45
29	5.4	....	4.25	4.95	4.35	3.65	2.8	2.6	2.75	3.8	4.0	5.2
30	5.4	....	4.65	4.9	4.6	3.85	2.8	2.6	....	3.5	3.8	5.2
31	6.1	....	6.1	....	4.35	....	2.8	2.6	....	3.4	....	5.0

NOTE.—Gage heights for May and June were affected by log jams.

Rating table for North Fork of Santiam River at Mehama, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.40	590	3.40	1,570	4.40	3,100	5.80	6,410	7.80	13,750
2.50	660	3.50	1,700	4.50	3,280	6.00	7,000	8.00	14,600
2.60	740	3.60	1,840	4.60	3,470	6.20	7,630	9.00	19,200
2.70	820	3.70	1,980	4.70	3,670	6.40	8,300	10.00	24,100
2.80	910	3.80	2,130	4.80	3,880	6.60	9,000	11.00	29,100
2.90	1,000	3.90	2,280	4.90	4,100	6.80	9,730	12.00	34,300
3.00	1,100	4.00	2,430	5.00	4,330	7.00	10,500	13.00	39,800
3.10	1,210	4.10	2,590	5.20	4,810	7.20	11,290		
3.20	1,320	4.20	2,750	5.40	5,320	7.40	12,090		
3.30	1,440	4.30	2,920	5.60	5,850	7.60	12,910		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905–1907 and is well defined between gage heights 2.5 feet and 4.5 feet.

Monthly discharge of North Fork of Santiam River at Mehama, Oreg., for 1905–6.

[Drainage area, 740 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
July 11–31	1,000	780	876	36,500	1.18	0.92
August	780	660	727	44,700	.982	1.13
September	3,010	625	952	56,600	1.29	1.44
October	9,730	1,500	3,460	213,000	4.68	5.40
November	3,880	1,000	1,830	109,000	2.47	2.76
December	6,700	2,430	4,010	247,000	5.42	6.25
The period				707,000		
1906.						
January	17,100	2,590	5,050	311,000	6.82	7.86
February	15,000	2,280	6,180	343,000	8.35	8.70
March	7,310	1,150	3,680	226,000	4.97	5.73
April	5,450	2,920	3,970	236,000	5.36	5.98
May	4,330	2,510	3,170	195,000	4.28	4.93
June	5,320	1,910	3,280	195,000	4.43	4.94
July	2,130	910	1,310	80,000	1.77	2.04
August	910	740	809	49,700	1.09	1.26
September	2,750	700	1,030	61,300	1.39	1.55
October	5,060	820	1,990	122,000	2.69	3.10
November	36,200	1,320	10,300	613,000	13.92	15.53
December	27,100	1,700	6,450	397,000	8.72	10.05
The year	36,200	700	3,930	2,830,000	5.31	71.67

NOTE.—Values are rated as follows: 1905, January, April, and July to December, 1906, excellent; May and June, 1906, fair; affected by log jams.

SOUTH FORK OF SANTIAM RIVER AT WATERLOO, OREG.

This station was established July 28, 1905. It is located about one-half mile below the highway bridge at Waterloo, Oreg. The station is about 4 miles above the mouth of Hamilton Creek, and about 3 miles above a dam which diverts water into a canal for the use of the town of Albany. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 225.

Discharge measurements of South Fork of Santiam River at Waterloo, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 28	L. R. Allen	150	246	1.06	375
1906.					
January 5	L. R. Allen	315	831	3.49	3,550
February 6	do	315	802	3.36	3,410
March 27	do	304	616	2.85	2,390
May 8	do	238	460	2.30	1,560
May 14	do	243	481	2.28	1.550
August 20	do	142	199	.93	263
September 26	J. E. Oakes	155	273	1.40	555

Daily gage height, in feet, of South Fork of Santiam River at Waterloo, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.7	4.6	4.6	4.4	3.1	3.2	2.2	1.2	0.7	1.2	2.9	2.5
2	3.2	4.4	4.2	3.7	2.4	3.0	2.1	1.2	.7	1.1	2.9	2.5
3	3.3	4.3	3.9	3.5	2.7	2.9	2.0	1.2	.7	1.5	2.9	2.4
4	3.2	3.9	3.9	3.3	2.7	3.5	1.8	1.1	.7	2.0	2.5	2.4
5	3.4	3.6	3.9	3.2	2.5	3.2	1.7	1.1	.7	1.6	2.3	2.5
6	3.5	3.4	4.0	3.1	2.4	3.6	1.8	1.1	.7	1.5	2.3	2.6
7	3.7	3.1	4.6	3.2	2.4	3.8	1.8	1.1	.7	1.3	7.4	3.5
8	3.6	3.1	4.4	3.1	2.3	4.3	1.7	1.1	.7	1.2	11.2	4.0
9	4.2	3.0	4.5	3.5	2.3	4.0	1.7	1.0	.7	1.1	6.6	3.7
10	4.0	2.9	4.2	3.2	2.3	3.4	1.6	1.0	.7	1.1	5.3	3.6
11	4.1	2.7	3.8	3.0	2.2	3.9	1.6	1.0	.7	1.0	5.6	3.6
12	4.3	2.6	3.5	2.8	2.2	3.3	1.6	1.0	.7	1.3	7.5	3.5
13	5.0	2.6	3.3	2.7	2.1	3.3	1.6	1.0	.7	1.5	10.0	3.7
14	4.4	2.6	3.2	2.6	2.3	3.1	1.5	1.0	1.8	1.3	13.5	3.3
15	4.3	3.0	2.9	2.6	2.6	3.1	1.5	1.0	1.9	1.4	10.0	4.1
16	4.6	3.0	2.7	2.7	2.8	3.7	1.5	1.0	1.7	1.5	8.5	4.0
17	5.4	3.4	2.7	2.6	2.6	3.7	1.5	1.0	1.7	4.4	8.5	3.6
18	5.0	3.8	2.6	2.5	2.6	3.2	1.5	1.0	1.7	4.0	8.2	4.5
19	4.4	5.9	2.6	2.5	2.8	3.0	1.4	1.0	1.4	4.7	8.1	7.7
20	3.9	7.0	2.5	2.5	2.7	2.7	1.4	.9	1.3	4.8	5.2	7.8
21	3.5	6.9	2.6	2.7	3.2	2.7	1.3	.8	1.2	2.3	5.1	6.5
22	3.4	5.9	2.6	2.6	3.4	2.6	1.3	.8	1.2	2.3	4.8	5.0
23	4.8	5.9	2.5	2.6	3.2	2.5	1.3	.8	1.2	2.1	4.2	4.85
24	7.1	5.9	2.6	2.6	3.0	2.4	1.3	.8	1.3	2.1	4.8	4.8
25	6.1	5.6	2.6	2.8	2.9	2.2	1.3	.8	1.3	2.3	3.5	5.6
26	5.5	5.3	2.8	3.8	2.4	2.2	1.2	.7	1.3	2.4	3.3	5.9
27	4.9	6.2	2.9	3.5	3.0	2.3	1.2	.7	1.0	2.9	3.4	4.8
28	4.5	5.1	2.8	3.7	2.9	2.3	1.2	.7	1.0	2.5	3.0	4.4
29	4.3	....	2.9	3.5	3.7	2.4	1.2	.7	1.1	2.2	2.7	4.0
30	4.5	....	2.8	3.2	3.8	2.4	1.2	.7	1.1	2.1	2.7	3.1
31	4.8	....	4.5	....	3.6	....	1.2	.7	....	2.3	....	3.8

Rating table for South Fork of Santiam River at Waterloo, Oreg., for 1905-6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	128	1.70	850	2.90	2,510	4.20	5,260	6.60	12,380
0.60	158	1.80	960	3.00	2,680	4.40	5,780	6.80	13,040
0.70	192	1.90	1,070	3.10	2,860	4.60	6,310	7.00	13,700
0.80	230	2.00	1,190	3.20	3,050	4.80	6,850	8.00	17,000
0.90	273	2.10	1,320	3.30	3,240	5.00	7,400	9.00	20,400
1.00	320	2.20	1,450	3.40	3,440	5.20	7,980	10.00	23,900
1.10	370	2.30	1,590	3.50	3,640	5.40	8,580	11.00	27,500
1.20	430	2.40	1,730	3.60	3,850	5.60	9,190	12.00	31,200
1.30	500	2.50	1,870	3.70	4,070	5.80	9,810	13.00	35,000
1.40	580	2.60	2,020	3.80	4,290	6.00	10,450	14.00	38,800
1.50	660	2.70	2,180	3.90	4,520	6.20	11,090		
1.60	750	2.80	2,340	4.00	4,760	6.40	11,730		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1905-6 and is well defined between gage heights 0.9 foot and 4 feet.

Monthly discharge of South Fork of Santiam River at Waterloo, Oreg., for 1905–6.

[Drainage area, 640 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.[a]						
August	345	230	297	18,300	.464	0.54
September	1,070	158	314	18,700	.491	.55
October	6,040	660	2,340	144,000	3.66	4.22
November	3,440	580	1,270	75,600	1.98	2.21
December	7,120	2,180	4,140	255,000	6.47	7.46
The period				512,000		
1906.[b]						
January	14,000	3,050	5,790	356,000	9.05	10.43
February	13,700	2,020	5,910	328,000	9.23	9.61
March	6,310	1,870	3,490	215,000	5.45	6.28
April	5,780	1,870	2,850	170,000	4.45	4.96
May	4,290	1,320	2,310	142,000	3.61	4.16
June	5,520	1,450	2,900	173,000	4.53	5.05
July	1,450	430	707	43,500	1.10	1.27
August	430	192	298	18,300	.466	.54
September	1,070	192	411	24,500	.642	.72
October	6,850	320	1,640	101,000	2.56	2.95
November	36,900	1,500	10,300	613,000	16.09	17.95
December	16,300	1,730	5,470	336,000	8.55	9.86
The period	36,900	192	3,510	2,520,000	5.48	73.78

[a] Values for 1905 are rated as follows: October to December, excellent; August and September, good.

[b] Values for 1906 are rated as follows: March to July, September, and October, excellent; remainder of the year, good.

LUCKIAMUTE RIVER NEAR SUVER, OREG.

This station was established August 18, 1905. It is located just below Helmick bridge on the public highway, 4 miles northwest of Suver, Oreg., 2 miles west of Parkers Station, and about 3 miles below the junction of the main forks of the river. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 226.

Discharge measurements of Luckiamute River near Suver, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 18	L. R. Alleu	45	121	1.47	73
October 7	do	79	571	8.57	1,180
1906.					
January 10	P. A. Cupper	78	508	7.60	928
April 5	L. R. Allen	62	322	5.01	495
May 16	do	62	356	5.59	592
June 30	do	61	290	4.28	396

Daily gage height, in feet, of Luckiamute River near Suver, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	15.6	8.35	15.8	6.8	3.95	4.0	3.8	2.0	1.25	1.5	3.5	6.9
2	12.3	7.5	13.6	5.9	3.85	3.6	3.75	1.85	.85	1.55	2.6	6.1
3	11.25	7.3	12.05	5.3	3.65	4.0	3.5	1.8	.95	2.45	3.0	7.3
4	9.5	7.4	10.8	5.1	4.35	4.4	3.5	1.2	1.25	2.85	4.0	5.9
5	7.75	6.5	9.95	5.0	4.6	4.8	3.25	1.85	1.2	1.95	8.2	5.5
6	8.2	6.2	9.3	5.1	5.25	4.25	3.1	1.85	1.2	1.6	7.1	5.7
7	8.5	5.7	8.55	4.9	5.0	4.9	3.05	1.75	1.2	1.45	10.9	13.0
8	7.8	5.45	8.1	4.8	3.1	5.1	3.05	1.85	1.15	1.8	23.1	12.5
9	9.0	5.3	7.6	5.0	3.2	4.8	2.9	1.8	.95	1.9	23.6	11.1
10	8.3	5.2	7.4	5.8	3.05	4.35	2.85	2.15	1.25	1.7	17.6	12.8
11	9.0	5.1	7.2	5.25	3.0	4.2	2.8	1.8	1.2	1.7	18.8	12.9
12	10.8	4.9	6.75	4.35	2.9	5.1	2.7	1.75	1.35	2.5	13.0	10.9
13	17.15	4.6	6.35	4.75	3.0	5.4	2.65	1.7	2.5	3.9	15.4	10.8
14	17.15	4.5	6.1	4.3	3.2	5.6	2.6	1.75	2.3	3.2	18.7	10.3
15	16.15	4.7	6.85	3.9	3.9	5.3	2.65	1.7	2.55	3.3	22.1	12.6
16	17.6	4.9	5.4	3.83	5.6	8.7	2.25	1.75	2.5	7.5	25.9	13.0
17	20.8	6.4	5.4	3.85	6.7	7.5	2.3	1.65	1.9	8.35	23.1	12.2
18	21.6	12.3	5.3	3.75	4.2	7.2	2.5	1.6	1.75	6.5	18.9	11.5
19	18.6	18.5	5.7	3.8	4.1	6.0	2.35	1.65	1.65	5.6	15.4	13.1
20	16.55	15.5	5.95	3.8	4.25	5.6	2.5	1.45	1.55	4.8	13.0	18.0
21	15.5	23.2	6.5	3.7	4.3	5.1	2.3	1.5	1.45	3.45	12.8	22.0
22	13.2	22.0	6.6	3.6	4.4	4.6	2.2	1.55	1.3	3.6	12.6	24.5
23	16.6	21.5	7.1	3.5	3.4	4.3	2.15	1.5	1.5	3.4	11.0	18.0
24	21.6	22.5	7.3	3.5	3.8	4.25	2.15	1.4	1.65	3.1	10.0	14.0
25	18.0	23.9	7.6	4.2	4.7	4.0	2.0	1.45	2.5	2.7	9.5	13.6
26	14.8	22.9	7.45	4.1	4.9	3.95	2.5	1.45	1.8	3.2	8.3	16.0
27	13.2	22.1	7.1	4.25	5.0	3.8	2.0	1.25	1.4	5.4	7.2	13.0
28	13.5	18.9	6.5	5.25	4.85	3.65	2.3	1.3	1.3	4.5	7.3	11.9
29	10.7	....	6.8	5.35	4.6	3.9	2.25	1.2	1.7	4.2	6.4	10.2
30	10.4	....	6.1	4.2	4.45	4.3	2.5	1.15	1.95	4.1	6.5	10.5
31	9.0	....	7.5	....	4.6	....	2.35	1.3	....	4.05	....	11.4

Rating table for Luckiamute River near Suver, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.90	39	2.30	143	3.70	306	6.20	701	17.00	3,770
1.00	44	2.40	153	3.80	319	6.40	737	18.00	4,148
1.10	50	2.50	163	3.90	333	6.60	774	19.00	4,540
1.20	56	2.60	173	4.00	347	6.80	812	20.00	4,944
1.30	62	2.70	184	4.20	375	7.00	850	21.00	5,360
1.40	69	2.80	195	4.40	405	8.00	1,058	22.00	5,780
1.50	76	2.90	206	4.60	435	9.00	1,290	23.00	6,200
1.60	83	3.00	218	4.80	466	10.00	1,543	24.00	6.630
1.70	91	3.10	230	5.00	498	11.00	1,810	25.00	7.060
1.80	99	3.20	242	5.20	530	12.00	2,095	26.00	7.490
1.90	107	3.30	254	5.40	563	13.00	2,400		
2.00	115	3.40	267	5.60	597	14.00	2,716		
2.10	124	3.50	280	5.80	631	15.00	3,060		
2.20	133	3.60	293	6.00	665	16.00	3,404		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1905–6 and is well defined between gage heights 1.5 feet and 9.0 feet.

Monthly discharge of Luckiamute River near Suver, Oreg., for 1905–6.

Month.	Discharge in second-feet.			Total in Acre-feet.
	Maximum.	Minimum.	Mean.	
1905.[a]				
August 26–31	76	41	55.4	1,320
September	280	39	76.6	4,560
October	1,290	133	396	24,300
November	1,000	115	247	14,700
December	4,400	375	1,450	89,200
The period				134,000
1906.[b]				
January	5,610	1,000	2,720	167,000
February	6,590	420	2,410	134,000
March	3,330	546	1,060	65,200
April	812	280	436	25,900
May	793	206	381	23,400
June	1,220	293	492	29,300
July	319	115	192	11,800
August	115	53	85	5,230
September	168	37	84.5	5,030
October	1,140	72	314	19,300
November	7,450	173	2,640	157,000
December	6,840	580	2,290	141,000
The year	7,450	37	1,090	784,000

[a] Values for 1905 are rated as follows: October, excellent; November and December, good; August and September, fair.

[b] Values for 1906 are rated as follows: April to June and October, excellent; March and July, good; remainder of the year, fair.

MOLALLA RIVER NEAR MOLALLA, OREG.

This station was established November 1, 1905. It is located at Dickey Prairie, 3 miles below the junction of the forks of the river 3½ miles southeast of Molalla, Oreg. The conditions at the station and the bench marks are described in Water-Supply Paper No. 178, page 227.

Discharge measurements of Molalla River near Molalla, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 2	L. R. Allen	106	226	1.83	376
1906.					
January 9[a]	L. R. Allen	130	437	3.63	1,510
January 13	P. A. Cupper	130	422	3.55	1,610
April 3	L. R. Allen	118	334	2.80	924
May 24	do	117	323	2.66	822
July 11	do	104	174	1.33	186
September 4	I. E. Oakes	102	118	.75	60

[a] Measurement unreliable.

Daily gage height, in feet, of Molalla River near Molalla, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	3.75	3.75	3.4	2.7	2.25	1.9	1.0	0.75	1.0	1.85	2.25
2	2.7	3.5	3.45	3.0	2.5	2.15	1.85	.95	.75	1.05	1.8	2.15
3	2.75	3.4	3.7	2.8	2.4	2.25	1.8	.95	.75	1.6	1.75	2.1
4	2.8	3.3	3.65	2.7	2.3	2.5	1.75	.95	.75	1.55	2.5	2.05
5	3.15	2.8	3.45	2.7	2.2	2.5	1.65	.9	.75	1.4	2.5	2.4
6	3.1	2.7	3.55	2.7	2.15	2.75	1.5	.9	.75	1.35	2.5	2.5
7	3.05	2.5	3.5	2.8	2.1	2.95	1.45	.9	.75	1.3	6.8	3.3
8	3.3	2.5	3.7	2.7	2.0	2.85	1.45	.9	.75	1.1	6.5	3.65
9	3.7	2.35	3.8	2.8	2.0	2.85	1.4	.9	.75	1.05	4.9	3.4
10	3.45	2.3	3.5	2.7	1.9	2.75	1.4	.9	.75	1.0	5.3	3.0
11	3.5	2.2	3.3	2.7	1.85	2.65	1.35	.9	.75	1.05	4.4	3.2
12	3.5	2.15	3.0	2.7	1.8	2.55	1.3	.85	.85	1.65	4.0	3.4
13	3.55	2.1	2.7	2.5	1.75	2.55	1.3	.85	1.3	2.2	7.45	2.8
14	3.5	2.05	2.65	2.45	2.15	2.5	1.25	.9	2.8	2.65	8.1	2.7
15	3.7	2.5	2.45	2.35	2.4	3.0	1.2	.9	2.5	2.2	8.85	3.4
16	3.9	2.5	2.3	2.35	2.35	4.0	1.2	.85	1.8	3.6	6.2	3.9
17	3.9	3.9	2.25	2.3	3.3	3.4	1.2	.85	1.45	3.9	6.0	3.2
18	3.95	5.0	2.2	2.25	2.3	3.0	1.2	.85	1.3	3.3	5.3	3.2
19	3.45	4.7	2.15	2.15	2.5	2.8	1.2	.85	1.2	3.1	4.4	3.5
20	3.1	5.9	2.1	2.1	2.7	2.5	1.15	.8	1.15	2.75	4.0	7.5
21	2.9	5.4	2.1	2.25	2.75	2.4	1.15	.8	1.15	2.5	3.8	6.0
22	2.95	4.5	2.05	2.25	2.8	2.3	1.15	.8	1.1	2.35	3.5	4.5
23	4.85	4.35	2.0	2.25	2.85	2.2	1.15	.8	1.2	2.1	3.4	4.2
24	5.2	4.5	2.2	2.2	2.65	2.1	1.1	.8	1.3	1.95	3.1	3.5
25	4.5	4.4	2.1	3.4	2.5	1.95	1.1	.8	1.2	1.9	2.9	4.2
26	4.0	4.6	2.35	3.0	2.65	1.85	1.1	.8	1.1	1.95	2.75	4.5
27	3.75	4.9	2.45	2.7	2.5	1.9	1.1	.75	1.05	1.95	2.6	3.9
28	3.5	4.35	2.4	3.1	2.5	1.95	1.1	.75	1.0	1.95	2.5	3.5
29	3.5	......	2.5	3.05	2.45	2.05	1.05	.75	.95	1.9	2.35	3.4
30	3.7	......	2.7	2.85	2.4	2.0	1.05	.75	.95	1.85	2.3	3.3
31	4.0	......	3.7	......	2.35	......	1.0	.75	......	1.85	......	3.2

Rating table for Molalla River near Molalla, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.70	52	1.70	320	2.70	855	3.70	1,595	5.40	3,225
0.80	68	1.80	364	2.80	920	3.80	1,680	5.60	3.435
0.90	86	1.90	411	2.90	985	3.90	1,770	5.80	3,645
1.00	106	2.00	460	3.00	1,055	4.00	1,860	5.00	3,855
1.10	127	2.10	510	3.10	1,125	4.20	2,040	7.00	4,955
1.20	151	2.20	565	3.20	1,200	4.40	2,225	8.00	6,105
1.30	178	2.30	620	3.30	1,275	4.60	2,415	9.00	7,305
1.40	208	2.40	675	3.40	1,350	4.80	2,610		
1.50	242	2.50	735	3.50	1,430	5.00	2,810		
1.60	279	2.60	795	3.60	1,510	5.20	3,015		

NOTE.—The above table is applicable only for open-channel conditions. It is based on discharge measurements made during 1905-6 and is well defined between gage heights 0.75 foot and 4.0 feet.

Monthly discharge of Molalla River near Molalla, Oreg., for 1905–6.

[Drainage area, 220 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.[a]						
November	1,600	164	464	27,600	2.11	2.35
December	2,320	592	1,190	73,200	5.41	6.24
The period	....	....	....	101,000	....	....
1906.[b]						
January	3,020	855	1,490	91,600	6.77	7.80
February	3,750	485	1,580	87,800	7.18	7.48
March	1,680	460	986	60,600	4.48	5.16
April	1,350	510	830	49,400	3.77	4.21
May	952	342	657	40,400	2.99	3.45
June	1,860	387	787	46,800	3.58	3.99
July	411	106	191	11,700	.868	1.00
August	106	60	77.6	4,770	.353	.407
September	920	60	164	9,760	.745	.831
October	1,770	106	512	31,500	2.33	2.69
November	7,120	242	2,170	129,000	9.86	11.00
December	5,530	485	1,510	92,800	6.86	7.91
The year	7,120	60	913	656,000	4.15	55.93

[a] Values for 1905 are rated as follows: November, excellent; December good.

[b] Values for 1906 are rated as follows: March to June, November and December, excellent; remainder of the year, good.

SOUTH FORK OF YAMHILL RIVER AT SHERIDAN, OREG.

This station was established April 25, 1906. It is located in Sheridan, Oreg., about 2 miles below the mouth of Mill Creek.

The channel is straight for 250 feet above and 500 feet below the station, and the current is uniform. Both banks are high and well covered with undergrowth; the right is liable to overflow at extreme high water. The bed of the stream is of sand and fine clean gravel and is liable to shift during high water. There is one channel at all stages.

Discharge measurements are made from the public highway bridge in Sheridan. The initial point for soundings is two nails driven in the wall, about 1 foot to the left of the corner of the first building on the right bank.

The gage, which is read daily by G. Schoppert, is a 2 by 8 inch timber in two sections, the lower section being vertical, 3.8 feet long, and nailed to a cross timber on the lower side of the right bridge pier. The upper portion is inclined at a small angle and nailed to an upright timber of the pier, being 24.3 feet in length. The bench mark is the top of three 30-penny nails driven in an ash tree about 5 feet below the bridge and 25 feet from the initial point; elevation, 21.70 feet above the datum of the gage.

Discharge measurements of South Fork of Yamhill River at Sheridan, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 14	L. R. Allen	122	428	....	583
1906.					
April 25	L. R. Allen	124	494	2.70	813
May 18	do	123	453	2.34	625
July 1	do	116	374	1.81	436
September 7	I. E. Oakes	106	211	.30	48
October 30	do	117	369	1.80	423

Daily gage height, in feet, of South Fork of Yamhill River at Sheridan, Oreg., for 1906.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	2.0	1.9	1.9	.8	.3	....	2.0	2.5
2	....	2.0	1.8	1.65	.7	.3	....	2.0	2.5
3	....	1.9	1.8	1.5	.7	.3	....	2.0	2.4
4	....	2.3	2.9	1.5	.7	.2	....	2.0	2.3
5	....	2.3	2.9	1.45	.6	.3	....	4.0	2.3
6	....	2.2	2.9	1.45	.6	.3	....	4.3	2.3
7	....	2.1	3.1	1.4	.6	.3	....	7.9	8.5
8	....	2.9	2.8	1.4	.6	.4	....	12.0	6.0
9	....	2.8	2.75	1.3	.6	.4	....	8.1	6.0
10	....	2.7	2.4	1.3	.5	.4	....	9.0	5.5
11	....	2.6	2.5	1.3	.5	.5	....	8.0	5.5
12	....	2.5	3.0	1.35	.5	.6	....	7.8	5.3
13	....	1.7	3.9	1.2	.5	1.4	....	7.5	5.2
14	....	1.7	4.0	1.1	.6	1.6	....	8.5	4.0
15	....	2.3	3.8	1.1	.5	1.7	....	14.5	4.5
16	....	2.3	5.0	1.0	.5	1.7	....	8.5	5.5
17	....	2.5	4.0	1.0	.5	1.6	....	9.5	5.5
18	....	2.4	3.6	1.0	.5	1.0	....	8.5	4.4
19	....	2.3	3.4	1.0	.5	.9	....	7.0	4.6
20	....	2.2	3.0	1.0	.4	.7	....	7.0	11.4
21	....	2.1	2.8	.9	.4	.7	....	5.5	11.6
22	....	2.0	2.6	.9	.4	.6	....	5.3	7.3
23	....	1.9	2.4	.9	.4	.7	....	5.0	7.0
24	....	2.0	2.2	.9	.4	.9	....	4.6	5.9
25	2.6	2.5	2.0	.9	.4	1.3	....	4.0	6.8
26	2.3	2.5	1.9	.8	.4	1.0	....	4.0	5.8
27	2.4	2.9	1.9	.8	.4	.9	....	3.5	5.8
28	2.5	2.3	1.95	.8	.3	.8	....	3.0	5.3
29	2.3	2.2	1.8	.8	.3	.8	....	2.8	4.5
30	2.2	2.1	2.1	.9	.3	....	1.8	2.5	4.8
31	....	2.1	....	.8	.3	....	1.9	....	4.5

Rating table for South Fork of Yamhill River at Sheridan, Oreg., from April 25 to September 30, 1906.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.20	38	1.10	208	2.00	500	2.90	895	3.80	1,395
0.30	51	1.20	235	2.10	540	3.00	945	3.90	1,455
0.40	65	1.30	264	2.20	580	3.10	995	4.00	1,515
0.50	80	1.40	294	2.30	620	3.20	1,050	4.20	1,645
0.60	97	1.50	326	2.40	665	3.30	1,105	4.40	1,775
0.70	116	1.60	359	2.50	710	3.40	1,160	4.60	1,915
0.80	137	1.70	393	2.60	755	3.50	1,215	4.80	2,055
0.90	159	1.80	428	2.70	800	3.60	1,275	5.00	2,200
1.00	183	1.90	464	2.80	845	3.70	1,335		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 4 discharge measurements made during 1906 and is not well defined.

Monthly discharge of South Fork of Yamhill River at Sheridan, Oreg., for 1906.

[Drainage area, 290 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
April 25–30	755	580	658	7,830	2.27	.51
May	805	303	614	37,800	2.12	2.44
June	2,200	428	873	51,900	3.01	3.36
July	464	137	225	13,800	.776	.90
August	137	51	81.0	4,980	.279	.32
September	393	38	149	8,870	.514	.57
The period				125,000		

NOTE.—The above estimates are provisional and subject to revision when more data are available. Values are rated as follows: April to June, good; July to September, fair.

CLACKAMAS RIVER NEAR BARTON, OREG.

This station was established October 2, 1905. It is located 2½ miles below Barton, Oreg., 1½ miles below the mouth of Deep Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 228.

Discharge measurements of Clackamas River near Barton, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
October 2	L. R. Allen	310	704	3.30	1,600
1906.					
January 8	L. R. Allen	310	1,070	4.52	3,310
January 13	do	325	1,160	4.84	4,020
April 2	do	324	1,290	5.18	4,950
May 23	do	304	1,010	4.30	3,250
July 10	do	276	640	3.01	1,270
September 3	Ivan Oakes	265	497	2.51	817

Daily gage height, in feet, of Clackamas River near Barton, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.4	5.6	5.6	5.9	4.9	3.8	3.4	2.7	2.52	2.6	3.2	4.5
2	4.3	5.4	5.3	5.3	4.7	3.8	3.4	2.7	2.52	2.7	3.1	4.5
3	4.1	5.2	5.3	4.9	4.5	3.8	3.3	2.7	2.52	2.8	3.1	4.5
4	4.1	4.9	5.1	4.7	4.5	4.1	3.2	2.7	2.52	3.0	3.2	4.4
5	4.36	4.7	5.0	4.7	4.4	4.0	3.2	2.7	2.52	2.9	3.7	4.4
6	4.45	4.5	5.0	4.8	4.3	4.2	3.1	2.65	2.51	2.8	3.5	4.6
7	4.52	4.4	5.0	5.0	4.2	4.5	3.1	2.65	2.51	2.7	7.15	6.0
8	4.5	4.2	5.1	5.1	4.2	4.3	3.1	2.65	2.51	2.7	10.0	6.5
9	4.9	4.1	5.3	5.5	4.2	4.5	3.0	2.6	2.51	2.7	7.0	6.0
10	4.9	4.0	5.4	5.3	4.2	4.2	3.0	2.6	2.51	2.6	6.3	5.7
11	4.9	3.9	5.2	5.0	4.1	4.2	3.0	2.6	2.51	2.6	6.6	5.6
12	4.9	3.8	4.8	4.7	4.1	4.1	3.0	2.6	2.54	2.7	5.7	5.3
13	4.9	3.8	4.6	4.6	3.9	4.1	3.0	2.6	2.8	2.8	10.1	5.1
14	4.7	3.7	4.5	4.6	3.8	4.0	3.0	2.6	3.3	3.1	10.6	5.0
15	4.6	3.8	4.4	4.6	4.3	4.0	3.0	2.6	4.1	3.1	11.9	4.9
16	4.6	3.9	4.1	4.7	4.2	5.3	3.0	2.6	3.3	4.3	10.7	6.6
17	4.9	4.0	4.1	4.7	4.0	5.0	3.0	2.6	3.0	4.6	10.5	6.1
18	5.1	5.8	4.0	4.5	4.0	4.7	3.0	2.6	2.8	4.7	8.6	5.7
19	4.75	8.2	3.9	4.5	3.9	4.5	3.0	2.6	2.75	4.4	7.0	5.9
20	4.5	7.1	3.9	4.5	4.0	4.2	3.0	2.55	2.7	4.0	6.5	11.0

Daily gage height, in feet, of Clackamas River, near Barton, Oreg., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	4.3	8.0	3.9	4.9	4.2	3.9	3.0	2.55	2.65	3.7	6.5	11.0
22	4.2	7.0	3.8	4.8	4.3	3.9	3.0	2.55	2.65	3.5	6.2	9.0
23	4.7	6.4	3.8	4.8	4.3	3.7	3.0	2.55	2.65	3.4	6.0	7.0
24	7.2	6.1	3.9	4.7	4.2	3.6	2.9	2.55	2.65	3.3	5.8	6.5
25	6.7	6.4	3.9	4.9	4.2	3.5	2.8	2.55	2.65	3.2	5.3	7.0
26	6.0	6.1	4.2	5.3	4.3	3.5	2.8	2.55	2.64	3.3	5.1	7.5
27	5.6	6.8	4.2	4.9	4.3	3.4	2.7	2.55	2.63	3.4	4.9	7.5
28	5.3	6.1	4.2	5.1	4.2	3.5	2.7	2.55	2.62	3.5	4.8	6.8
29	5.2	....	4.2	5.1	4.0	3.5	2.7	2.54	2.61	3.4	4.7	6.2
30	5.3	....	4.4	5.0	4.0	3.6	2.7	2.53	2.6	3.2	4.6	6.1
31	5.6	....	5.7	....	3.9	....	2.7	2.53	....	3.2	....	5.9

Rating table for Clackamas River near Barton, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
2.50	810	3.50	1,860	4.50	3,480	5.50	5,560	7.00	9,460
2.60	890	3.60	2,000	4.60	3,670	5.60	5,790	7.20	10,040
2.70	970	3.70	2,140	4.70	3,860	5.70	6,030	7.40	10,620
2.80	1,060	3.80	2,290	4.80	4,050	5.80	6,270	7.60	11,220
2.90	1,160	3.90	2,450	4.90	4,250	5.90	6,510	7.80	11,820
3.00	1,260	4.00	2,610	5.00	4,460	6.00	6,760	8.00	12,430
3.10	1,370	4.10	2,780	5.10	4,670	6.20	7,270	9.00	15,530
3.20	1,480	4.20	2,950	5.20	4,890	6.40	7,790	10.00	18,730
3.30	1,600	4.30	3,120	5.30	5,110	6.60	8,330	11.00	22,030
3.40	1,730	4.40	3,300	5.40	5,330	6.80	8,890	12.00	25,430

NOTE.—The above table is applicable only for open-channel conditions. It is based on 7 discharge measurements made during 1905-6 and is well defined below gage height 5.5 feet.

Monthly discharge of Clackamas River near Barton, Oreg., for 1905–6.

[Drainage area, 800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.[a]						
November 11-30	3,860	1,160	2,060	81,700	2.58	1.92
December	5,490	2,290	3,800	234,000	4.75	5.48
The period	....	....	....	316,000	....	....
1906.[b]						
January	10,000	2,780	4,400	271,000	5.50	6.34
February	13,000	2,140	5,430	302,000	6.79	7.07
March	6,030	2,290	3,700	228,000	4.62	5.33
April	6,510	3,480	4,280	255,000	5.35	5.97
May	4,250	2,290	2,960	182,000	3.70	4.27
June	5,110	1,730	2,730	162,000	3.41	3.80
July	1,730	970	1,260	77,500	1.58	1.82
August	970	834	890	54,700	1.11	1.28
September	2,780	818	1,010	60,100	1.26	1.41
October	3,860	890	1,650	101,000	2.06	2.38
November	25,100	1,370	8,720	519,000	10.90	12.16
December	22,000	3,300	7,690	473,000	9.61	11.08
The year	25,100	818	3,730	2,690,000	4.66	62.91

[a] Values for 1905 are rated as excellent.

[b] Values for 1906 are rated as follows: January to October, excellent; November and December good.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Willamette River drainage basin in 1906:

Boulder Creek near Detroit, Oreg.—The flow of this stream was estimated September 5, 1906, at 5 second-feet.

Breitenbush Creek near Detroit, Oreg.—A measurement was made at low water, September 4, 1906, just above the mouth of the creek.

Width, 59 feet; area, 100 square feet; discharge, 184 second-feet.

Calapooia Creek.—A measurement was made 300 yards below Kendall's bridge in sec. 19, T. 12 S., R. 3 W., at low water, August 23, 1906.

Width, 50 feet; area, 38 square feet; discharge, 64 second-feet.

Crabtree Creek near Thomas, Oreg.—A measurement was made 100 yards below the bridge in sec. 27, T. 10 S., R. 2 W., at low water August 24, 1906.

Width, 51 feet; area, 59 square feet; discharge, 55 second-feet.

Long Tom Creek near Junction City, Oreg.—A measurement was made 75 feet above the highway bridge, in sec. 10, T. 16 S., R. 5 W., at low water August 18, 1906.

Width, 42 feet; area, 29 square feet; discharge, 22 second-feet.

Marys Creek near Philamath, Oreg.—A measurement was made at the bridge in sec. 11, T. 12 S., R. 6 W., at low water August 25, 1906.

Width, 50 feet; area, 31 square feet; discharge, 18 second-feet.

Minto Creek.—The two channels of this stream were measured in sec. 10, T. 11 S., R. 7 E., at low water September 6, 1906.

The surface of the right channel was 3.22 feet below a spike in a large cedar just upstream from the trail crossing.

Width, 10 feet; area, 3.7 square feet; discharge, 3.7 second-feet.

The water surface of the left channel was 3.35 feet below a nail in a 10-inch cedar on the right bank just above the trail crossing.

Width, 7 feet; area, 3.3 square feet; discharge, 6.7 second-feet.

Mohawk River near Mohawk, Oreg.—A measurement was made by wading, August 16, 1906, 50 feet above the highway bridge in sec. 9, T. 17 S., R. 2 W.

Width, 62 feet; area, 64 square feet; discharge, 37 second-feet.

Permelia Creek.—A measurement was made in sec. 33, T. 10 S., R. 7 E., at low water, September 6, 1906. The water surface was 5.20 feet below a nail in a 6-inch alder 30 feet upstream from the Minto trail crossing.

Width, 39 feet; area, 32 square feet; discharge, 80 second-feet.

Roaring Creek.—This stream is very rocky and rough and has an enormous fall. A measurement was made in T. 11 S., R. 7 E., at low water, September 7, 1906. The water surface was 3.84 feet below a spike in an 18-inch alder on the right bank near the Minto trail crossing.

Width, 19 feet; area, 26 square feet; discharge, 65 second-feet.

Santiam River at Jefferson, Oreg.—This station is described in Water-Supply Paper 178, page 224. Gage readings were discontinued during 1906, as the flow was obstructed by logs. The following measurements were made during 1906:

January 3, width, 314 feet; area, 3,060 square feet; gage height, 4.76 feet; discharge, 5,790 second-feet.

March 30, width, 311 feet; area, 2,950 square feet; gage height, 5.50 feet; discharge, 6,170 second-feet.

Marion Fork of Santiam River.—A measurement was made in sec. 15, T. 11 S., R. 7 E., at low water, September 6, 1906. The water surface was 4.76 feet below a spike in a yew tree on the right bank, 30 feet upstream from the foot log.

Width, 52 feet; area, 91 square feet; discharge, 157 second-feet.

A measurement was made September 7, 1906, 200 feet below the outlet of Lake Marion. The water surface was 4.45 feet below a spike in a small alder, on the right bank 30 feet downstream from water-right notice.

Width, 31 feet; area, 51 square feet; discharge, 77 second-feet.

Middle Fork of Santiam River.—The following measurement was made near Foster, Oreg., at low water, September 3, 1906.

Width, 96 feet; area, 183 square feet; discharge, 66 second-feet.

The following measurement was made at Withcombe Place, Oreg., at low water, September 4, 1906.

Width, 60 feet; area, 144 square feet; discharge, 82 second-feet.

North Fork of North Fork of Santiam River near Mehama, Oreg.—A measurement was made in sec. 18, T. 9 S., R. 2 E., at old fort one-half mile above Mehama, at low water, August 21, 1906.

Width, 59 feet; area, 40 square feet; discharge, 54 second-feet.

North Fork of Santiam River in sec. 12, T. 10 S., R. 5 E.—A measurement was made at low water, August 22, 1906, opposite the mill above Detroit, Oreg.

Width, 58 feet; area, 387 square feet; discharge, 469 second-feet.

A measurement was made September 4, 1906, below the mouth of Breitenbush Creek. The water surface was 3.68 feet below a spike in the upstream face of the foot log near the right bank.

Width, 110 feet; area, 282 square feet; discharge, 564 second-feet.

A measurement was made September 5, 1906, above the mouth of Breitenbush Creek. The water surface was 5.95 feet below a shelf cut into rock on the right bank for a brace to the footbridge.

Width, 60 feet; area, 456 square feet; discharge, 433 second-feet.

North Fork of Santiam River T. 11 S., R. 7 E.—A measurement was made above the mouth of Marion Fork, September 6, 1906, at low water.

East channel, width, 30 feet; area, 45 square feet; discharge, 43 second-feet. West channel, width, 36 feet; area, 44 square feet; discharge, 53 second-feet.

South Fork of Santiam River.—A measurement was made 150 yards below Sanderson bridge in sec. 4, T. 11 S., R. 2 W., on August 24, 1906.

Width, 76 feet; area, 50 square feet; discharge, 51 second-feet.

A measurement was made at Foster, September 3, 1906.

Width, 87 feet; area, 163 square feet; discharge, 131 second-feet.

A measurement was made at Withcombe Place, September 3, 1906.

Width, 60 feet; area, 144 square feet; discharge, 82 second-feet.

Thomas Fork of Santiam River at Scio, Oreg.—A measurement was made above the bridge in sec. 18, T. 10 S., R. 1 W., August 24, 1906.

Width, 34 feet; area, 28 square feet; discharge, 28 second-feet.

Whitewater Creek in SW. ¼ sec. 21, T. 10 S., R. 7 E.—A measurement was made one-fourth mile above the mouth September 6, 1906. The water surface was 4.49 feet below the reference point on a cedar tree 100 feet upstream from a log cabin near the Minto trail.

Width, 32 feet; area, 28 square feet; discharge, 65 second-feet.

PUGET SOUND DRAINAGE BASIN.

DESCRIPTION OF BASIN.

The streams flowing into Puget Sound drain the western slope of the Cascade Mountains in Washington. Their areas are heavily timbered and mountainous. The precipitation is high, varying from 40 to 100 inches per annum. The streams draining this area are principally valuable for power and logging purposes. Little or no irrigation is practiced.

SNOHOMISH RIVER DRAINAGE BASIN.

SNOQUALMIE RIVER NEAR SNOQUALMIE FALLS, WASH.

Snoqualmie and Skykomish rivers unite to form Snohomish River, which flows into Puget Sound about 10 miles beyond the junction, near Everett, Wash. The following gage heights were furnished by the Seattle-Tacoma Power Company, of Seattle, Wash. The gage is referred to mean sea datum and is not the one referred to in Water-Supply and Irrigation Paper No. 178, page 233.

Daily gage height, in feet, of Snoqualmie River near Snoqualmie Falls, Wash., for 1906.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1	561.8	561.2	12	565.9	561.9	23	561.9	563.6
2	561.3	561.6	13	566.6	561.9	24	561.7	562.9
3	561.1	561.3	14	570.0	561.3	25	561.5	562.8
4	561.6	561.5	15	570.2	561.5	26	561.5	562.0
5	561.7	562.0	16	570.0	562.0	27	561.6	561.8
6	561.9	562.4	17	564.2	562.8	28	561.6	561.7
7	562.8	563.0	18	563.4	562.5	29	561.6	561.7
8	562.6	562.4	19	562.9	563.0	30	561.6	561.7
9	563.0	562.4	20	562.4	564.6	31	....	561.7
10	564.5	561.9	21	562.3	564.5			
11	563.0	561.9	22	562.2	563.9			

WHITE RIVER DRAINAGE BASIN.

White River rises near Mount Rainier and flows into Puget Sound near Seattle. Cedar River is a branch of White River.

CEDAR RIVER NEAR RAVENSDALE, WASH.

This station was established September 27, 1902. It is located at the intake of the Seattle waterworks pipe line and is 15 miles below Cedar Lake, 4 miles from the Northern Pacific Railway at Ravensdale, and 6 miles from the Columbia and Puget Sound Railway at Maple Valley. The discharge of the pipe line is practically constant at 34 second-feet. The conditions at this station and the bench marks are described in Water-Supply Paper No. 178, page 230, where are given also references to publications that contain data for previous years.

The following measurement was made October 21, 1906:

Width, 128 feet; area, 1,060 square feet; gage height, 1.40 feet; discharge, 864 second-feet.

Daily gage height, in feet, of Cedar River near Ravensdale, Wash., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.30	2.18	1.56	1.39	1.30	1.13	1.09	0.62	0.55	0.58	1.38	1.17
2	1.26	2.14	1.47	1.41	1.31	1.15	1.07	.63	.57	.60	1.32	1.88
3	1.21	2.07	1.39	1.36	1.27	1.07	1.04	.62	.57	.62	1.20	1.08
4	1.31	1.96	1.31	1.29	1.26	1.18	1.01	.63	.56	.66	1.18	1.07
5	1.48	1.92	1.28	1.26	1.21	1.12	.97	.65	.57	.62	1.12	1.09
6	1.83	1.77	1.26	1.27	1.16	1.14	.93	.65	.57	1.20	1.08	1.25
7	1.76	1.64	1.27	1.33	1.13	1.15	.90	.63	.59	1.14	1.21	1.64
8	1.76	1.56	1.30	1.37	1.10	1.12	.89	.62	.60	1.00	1.40	1.70
9	1.71	1.47	1.35	1.48	1.10	1.11	.87	.61	.59	1.06	1.50	1.64
10	1.64	1.42	1.41	1.42	1.13	1.10	.86	.61	.58	1.14	1.71	1.57
11	1.51	1.36	1.40	1.36	1.10	1.12	.82	.60	.58	1.25	2.00	1.44
12	1.47	1.31	1.37	1.33	1.08	1.13	.82	.60	.61	1.32	2.20	1.36
13	1.45	1.29	1.30	1.26	1.09	1.12	.82	.60	.64	1.35	3.64	1.27
14	1.37	1.26	1.25	1.22	1.08	1.11	.77	.61	.72	1.42	6.77	1.26
15	1.31	1.20	1.20	1.19	1.04	1.13	.75	.60	.64	1.43	8.65	1.27
16	1.28	1.18	1.19	1.18	1.13	1.21	.74	.59	.60	1.55	6.35	1.64
17	1.29	1.20	1.16	1.21	1.11	1.16	.72	.60	.58	1.60	4.10	1.65
18	1.25	1.31	1.14	1.21	1.06	1.12	.72	.59	.59	1.54	3.11	1.62
19	1.21	1.92	1.10	1.20	1.07	1.15	.69	.60	.57	1.41	2.55	1.72
20	1.17	1.99	1.07	1.19	1.05	1.09	.68	.60	.57	1.40	2.22	2.73

Daily gage height, in feet, of Cedar River near Ravensdale, Wash., for 1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	1.15	2.06	1.05	1.27	1.04	1.12	.67	.59	.56	1.29	2.10	3.02
22	1.23	1.95	1.05	1.37	1.04	1.14	.66	.58	.55	1.20	1.91	2.85
23	1.68	1.85	1.04	1.44	1.08	1.12	.65	.57	.57	1.15	1.71	2.52
24	2.25	1.84	1.02	1.38	1.07	1.06	.65	.59	.60	1.06	1.58	2.30
25	2.67	1.76	1.01	1.35	1.02	1.05	.63	.58	.59	1.25	1.52	2.02
26	2.47	1.78	1.01	1.31	1.06	1.04	.63	.58	.58	2.11	1.47	1.83
27	2.25	1.71	1.07	1.28	1.04	1.01	.66	.56	.58	2.24	1.39	1.77
28	2.10	1.67	1.04	1.26	1.06	1.01	.65	.58	.57	1.94	1.24	1.64
29	2.01	......	1.03	1.25	1.03	1.13	.63	.57	.57	1.73	1.18	1.60
30	2.00	......	1.04	1.27	1.02	1.11	.64	.57	.57	1.59	1.77	1.50
31	2.10	......	1.29	......	1.14	......	.63	.57	......	1.47	......	1.45

NOTE.—These gage heights were read with a hook gage and give the height above the crest of the diversion dam of the Seattle water-system pipe line

Rating table for Cedar River near Ravensdale, Wash., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.50	180	1.60	910	2.70	1,940	3.70	3,100	5.40	5,450
0.60	230	1.70	990	2.80	2,050	3.80	3,220	5.60	5,750
0.70	285	1.80	1,075	2.90	2,160	3.90	3,350	5.80	6,050
0.80	340	1.90	1,160	3.00	2,270	4.00	3,480	6.00	6,370
0.90	400	2.00	1,250	3.10	2,380	4.20	3,740	6.20	6,690
1.00	465	2.10	1,340	3.20	2,500	4.40	4,000	6.40	7,010
1.10	530	2.20	1,430	3.30	2,620	4.60	4,280	6.60	7,330
1.20	600	2.30	1,530	3.40	2,740	4.80	4,560	6.80	7,660
1.30	675	2.40	1,630	3.50	2,860	5.00	4,850	7.00	8,000
1.40	750	2.50	1,730	3.60	2,980	5.20	5,150	8.00	9,700
1.50	830	2.60	1,830						

NOTE.—The above table is computed for discharges over a steel-shod triangular weir 120 feet long, which approximates in shape type O in Hazen and Whipple's discussion of irregular weirs. It includes the discharge of the Seattle water-supply pipe line.

Monthly discharge of Cedar River near Ravensdale, Wash., for 1905–6.

[Drainage area, 170 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
January	1,010	376	623	38,300	3.66	4.22
February	1,010	280	535	29,700	3.15	3.28
March	1,070	420	742	45,600	4.36	5.03
April	870	485	618	36,800	3.64	4.06
May	1,980	406	807	49,600	4.75	5.48
June	1,190	394	656	39,000	3.86	4.31
July	472	274	336	20,700	1.98	2.28
August	268	180	236	14,500	1.39	1.60
September	246	195	215	12,800	1.26	1.41
October	1,230	180	710	43,700	4.18	4.82
November	950	290	478	28,400	2.81	3.14
December	1,070	524	728	44,800	4.28	4.93
The year	1,980	180	557	404,000	3.28	44.56
1906.						
January	1,910	565	950	58,400	5.59	6.44
February	1,410	586	976	54,200	5.74	5.98
March	878	472	610	37,500	3.59	4.14
April	814	586	678	40,300	3.99	4.45
May	682	478	538	33,100	3.16	3.64
June	608	472	540	32,100	3.18	3.55
July	524	246	334	20,500	1.96	2.26
August	258	210	231	14,200	1.36	1.57
September	296	205	224	13,300	1.32	1.47
October	1,470	220	688	42,300	4.05	4.67
November	10,800	517	1,870	111,000	11.00	12.27
December	2,290	510	1,010	62,100	5.95	6.86
The year	10,800	205	721	519,000	4.24	57.30

NOTE.—Values for 1905-6 are rated as good. Discharge includes 34 second-feet diverted by the Seattle water supply pipe line.

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in Puget Sound drainage basin during 1906:

Baker River near Baker, Wash.—A measurement was made November 5, 1906, at the highway bridge between Baker and Concrete. The water surface was 24.25 feet below the top of the first floor beam from the left downstream pier. The stage was about 3 feet above low water, and 15 feet below high water.

Width, 150 feet; area, 737 square feet; discharge, 3,180 second-feet.

Creeks near Baker, Wash.—The discharge of the first creek below the head-gate of the Washington Portland Cement Company's power flume was estimated November 5, 1906, as 8 second-feet. This stream is a series of cascades. The discharge of the second from the head-gate was estimated as 6 second-feet.

Carbon River.—This stream rises in Mount Rainier and flows into Puyallup River. It is a glacial stream and is always white with suspended matter. A measurement was made near the mouth of Canada Creek, September 26, 1906, which was not low water for the season.

Width, 31 feet; area, 54 square feet; discharge, 145 second-feet.

A measurement was made September 27, 1906, at the railroad bridge at Fairfax, Wash. The water surface was 8.55 feet below the top of the retaining wall forming the right abutment downstream side.

Width, 54 feet; area, 103 square feet; discharge, 455 second-feet.

Canada Creek.—This stream is a tributary of Carbon River. A measurement was made near the mouth September 26, 1906. The water surface was 3.52 feet below a nail in a small cedar near the mouth.

Width, 7 feet; area, 3.2 square feet; discharge, 5.5 second-feet.

Chenuis Creek.—A measurement was made near the junction with Carbon River, September 27, 1906.

Width, 14 feet; area, 14 square feet; discharge, 15 second-feet.

NORTHERN PACIFIC OCEAN DRAINAGE.

DESCRIPTION OF BASIN.

The streams draining the western slope of the Coast Range in Oregon are comparatively short, but, owing to the heavy precipitation on their catchment basins, carry large quantities of water. The area throughout this region is mountainous and heavily timbered. A considerable portion of the timbered area has been burned over. The principal streams in this basin are the Siletz, Alseya, Suislaw, Smiths, Umpqua, Coquille, Illinois, and Rogue rivers.

SILETZ RIVER BASIN.

SILETZ RIVER AT SILETZ, OREG.

This station was established November 25, 1905. It is located at Siletz, Oreg., about 1 mile above the ferry on the Siletz and Toledo stage road, 6 miles below the mouth of Rock Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 252.

Discharge measurements of Siletz River at Siletz, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
November 26	L. R. Allen	157	394	2.15	1,1[illegible]
1906.					
February 9	L. R. Allen	156	338	1.77	[illegible]
March 29	do	157	370	2.03	1,[illegible]
May 10	do	157	303	[a]1.50	[illegible]
July 23	do	151	231	1.23	[illegible]
September 24	I. E. Oakes	155	289	1.60	[illegible]

[a] Possible backwater effect from small dam 75 feet below.

Daily gage height, in feet, of Siletz River at Siletz, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.5	2.5	3.6	2.3	1.9	1.9	2.1	1.15	0.85	1.4	2.0	2.0
2	3.8	2.4	3.0	2.2	1.85	1.85	2.0	1.1	.85	1.5	2.0	2.0
3	3.3	2.3	2.7	2.1	1.8	1.9	1.85	1.1	.85	1.8	2.2	2.0
4	3.0	2.2	2.9	2.0	1.75	2.3	1.8	1.1	.85	1.7	3.0	2.7
5	2.9	2.1	2.9	1.95	1.7	2.6	1.75	1.1	.85	1.6	3.4	2.9
6	2.8	2.0	2.9	1.9	1.65	2.7	1.65	1.1	.85	1.6	3.7	6.2
7	2.7	1.9	2.7	1.8	1.6	2.65	1.6	1.05	.85	1.5	10.74	4.2
8	2.9	1.8	2.6	1.75	1.6	2.6	1.55	1.05	.95	1.5	12.5	4.0
9	2.9	1.8	2.5	2.2	1.55	2.55	1.5	1.05	.95	1.45	7.1	3.7
10	2.8	1.7	2.4	2.0	1.55	2.6	1.5	1.05	.9	1.6	9.1	3.5
11	3.0	1.7	2.3	1.9	1.5	2.6	1.45	1.0	.9	2.0	6.3	3.5
12	3.6	1.6	2.1	1.85	1.5	2.7	1.4	1.0	.95	1.9	7.0	3.1
13	5.8	1.6	2.1	1.8	1.5	3.35	1.4	1.0	1.6	1.85	8.4	3.0
14	4.8	1.5	2.0	1.75	2.0	3.1	1.4	1.0	2.0	1.85	13.5	2.8
15	4.2	1.5	1.9	1.7	2.4	3.06	1.35	1.0	1.95	2.65	16.6	3.0
16	5.0	1.8	1.8	1.7	2.65	4.1	1.35	1.0	1.5	4.0	9.9	4.0
17	5.8	2.8	1.8	1.65	2.4	3.55	1.3	.95	1.35	3.9	9.7	3.7
18	5.6	6.6	1.8	1.6	2.3	3.1	1.3	.95	1.25	3.6	7.6	3.5
19	4.8	6.05	1.8	1.6	2.2	2.8	1.3	.95	1.15	3.1	5.5	4.1
20	4.0	7.6	1.9	1.55	2.2	2.6	1.3	.95	1.15	2.7	4.4	11.5
21	3.5	7.9	2.1	1.5	2.3	2.4	1.25	.95	1.1	2.6	4.1	12.9
22	3.8	6.9	2.1	1.5	2.2	2.25	1.25	.95	1.1	2.4	3.7	7.0
23	6.2	5.8	2.3	1.5	2.1	2.1	1.25	.9	1.4	2.25	3.5	5.1
24	8.1	6.4	2.4	2.35	2.0	2.0	1.25	.9	1.6	2.1	3.2	4.0
25	5.7	6.7	2.3	2.15	2.05	1.95	1.2	.9	1.6	2.5	2.9	3.8
26	4.4	6.4	2.2	2.2	2.3	1.9	1.2	.9	1.5	3.3	2.7	3.6
27	3.7	6.4	2.2	2.2	2.25	1.8	1.2	.9	1.5	3.0	2.5	3.45
28	3.2	4.7	2.1	2.2	2.2	1.8	1.2	.9	1.4	2.7	2.4	3.15
29	2.9	......	2.0	2.1	2.1	2.2	1.2	.9	1.4	2.55	2.3	3.0
30	2.6	......	2.1	2.0	2.05	2.4	1.15	.9	1.4	2.4	2.1	3.0
31	2.6	......	2.3	......	2.0	......	1.15	.85	......	2.2	......	2.9

Rating table for Siletz River at Siletz, Oreg., for 1906.

Gage height.	Discharge	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.85	130	1.40	425	2.00	990	2.60	1,790	3.40	3,070
0.90	150	1.50	500	2.10	1,110	2.70	1,940	3.60	3,410
1.00	195	1.60	580	2.20	1,230	2.80	2,090	3.80	3,770
1.10	245	1.70	670	2.30	1,360	2.90	2,250	4.00	4,130
1.20	300	1.80	770	2.40	1,500	3.00	2,410		
1.30	360	1.90	880	2.50	1,640	3.20	2,730		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 5 discharge measurements made during 1905–6 and is well defined between gage heights 1.2 feet and 2.2 feet.

Monthly discharge of Siletz River at Siletz, Oreg., for 1906.

[Drainage area, 220 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
March	3,410	770	1,430	87,900	6.50	7.49
April	1,430	500	899	53,500	4.09	4.56
May	1,860	500	990	60,900	4.50	5.19
June	4,310	770	1,700	101,000	7.73	8.62
July	1,110	272	467	28,700	2.12	2.44
August	272	130	191	11,700	.868	1.00
September	990	130	345	20,500	1.57	1.75
October	4,130	425	1,480	91,000	6.73	7.76
November 1–7	3,590	990	1,750	24,300	7.95	2.07
The period	....	....	....	480,000	....	....

NOTE.—The above estimates are provisional and subject to revision when more data are available. Values are rated as follows: April, May, and July, excellent; March, June, and August to November, good.

UMPQUA RIVER DRAINAGE BASIN.

UMPQUA RIVER AT ELKTON, OREG.

This station was established October 18, 1905, by J. G. Kelley, of Portland, Oreg., by whom it is maintained and the results furnished to the Geological Survey. It is located at Smiths Ferry, 4 miles above Elkton.

The gage is 100 feet above the ferry, on the left bank. It is an inclined staff fastened to bed rock. The gage datum is low water.

The following measurement was made August 11, 1906:

Width, 365 feet; area, 1,560 square feet; gage height, 0.07 foot; discharge, 1,340 second-feet.

Daily gage height, in feet, of Umpqua River near Elkton, Oreg., for 1905–6.

1905.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1	......	0.08	2.88	12	......	0.00	1.67	23	.08	.62	2.54
2	......	.00	2.38	13	......	.00	1.38	24	.08	.42	2.12
3	......	.00	2.00	14	......	.00	1.21	25	.17	.29	1.42
4	......	.00	2.33	15	......	.00	1.12	26	.17	.25	1.75
5	......	.00	2.42	16	......	.00	1.05	27	.67	.25	6.00
6	......	.00	2.67	17	......	.00	.08	28	.71	1.42	5.71
7	......	.00	3.12	18	0.08	.00	1.21	29	.58	1.29	4.46
8	......	.00	3.08	19	.75	.00	1.42	30	.58	1.88	4.08
9	......	.00	2.88	20	.50	.50	2.33	31	.38	......	8.29
10	......	.00	2.38	21	.42	1.62	4.29				
11	......	.00	1.96	22	0.25	1.21	3.29				

Daily gage height, in feet, of Umpqua River near Elkton, Oreg., for 1905–6—Continued.

1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.08	5.50	7.50	7.33	3.58	6.29	1.75	0.25	0.00	0.00	0.00	1.38
2	6.08	5.00	6.17	6.58	3.29	5.46	1.75	.25	.00	.00	.00	1.29
3	3.38	4.42	6.05	5.71	3.12	4.88	1.67	.17	.00	.00	.00	1.12
4	3.46	4.50	5.75	5.29	3.00	4.88	1.50	.17	.00	.00	.00	1.00
5	3.46	4.12	5.75	5.29	3.00	4.83	1.38	.17	.00	.00	.25	1.00
6	3.38	3.79	5.05	4.62	3.05	4.58	1.33	.17	.00	.00	.12	1.66
7	3.50	3.54	5.25	4.33	2.96	4.79	1.17	.17	.00	.00	1.50	1.42
8	3.50	3.29	5.25	4.17	2.75	4.88	1.00	.17	.00	.00	3.75	3.08
9	4.29	3.17	5.21	4.05	2.75	4.83	1.00	.17	.00	.00	3.75	5.21
10	6.88	3.05	5.12	4.17	2.58	4.83	.88	.17	.00	.00	3.12	5.58
11	5.62	2.96	5.00	3.88	2.75	5.38	.75	.17	.00	.00	2.25	5.73
12	5.29	2.79	5.00	3.54	2.71	4.75	.75	.17	.00	.08	2.21	5.21
13	9.88	2.62	5.00	3.21	2.58	4.50	.75	.17	.00	.12	1.96	4.62
14	8.88	2.50	5.00	3.12	2.46	4.08	.75	.08	.29	.08	2.33	3.88
15	8.17	2.62	4.17	3.00	2.54	4.25	.75	.08	1.17	.12	2.92	3.54
16	13.79	3.08	3.12	3.00	4.12	4.42	.62	.08	1.00	.21	6.33	5.62
17	18.33	3.25	3.00	3.00	3.96	4.50	.54	.08	.75	.29	5.50	6.33
18	10.42	3.67	3.00	2.96	3.58	3.96	.50	.00	.54	1.21	7.17	4.75
19	8.46	6.88	3.00	2.67	3.38	3.62	.50	.00	.46	1.12	5.83	4.67
20	6.79	9.05	3.00	2.67	3.08	3.29	.50	.00	.42	1.00	4.50	6.08
21	5.88	15.38	3.50	2.75	2.96	3.00	.46	.00	.33	.67	4.00	6.67
22	5.21	13.08	4.17	2.88	3.46	2.92	.42	.00	.25	.38	4.58	5.42
23	5.05	11.62	4.50	3.08	4.46	2.67	.42	.00	.12	.29	4.58	4.79
24	8.62	11.33	4.29	3.08	4.21	2.42	.33	.00	.08	.00	3.50	4.42
25	8.29	11.38	4.17	3.08	3.46	2.25	.25	.00	.17	.00	3.05	5.21
26	7.58	9.75	4.29	3.17	3.75	2.17	.25	.00	.17	.00	2.67	8.21
27	6.62	10.88	4.46	3.33	3.88	2.00	.25	.00	.05	.00	2.29	8.21
28	5.83	8.62	4.12	3.75	4.58	2.00	.25	.00	.00	.00	2.00	6.75
29	5.38	....	3.96	4.00	13.21	2.00	.25	.00	.00	.00	1.88	5.33
30	4.54	....	3.75	3.88	10.25	1.96	.25	.00	.00	.00	9.67	4.79
31	5.42	....	3.75	....	8.50	....	.25	.00	....	.00	....	5.62

NORTH FORK OF UMPQUA RIVER NEAR OAKCREEK, OREG.

This station was established September 6, 1905. It is located 3 miles west of Oakcreek, Oreg., 1¼ miles above J. R. Dixon's farmhouse, about 10 miles below the mouth of East Fork of North Fork of Umpqua River. The conditions at the station and the bench marks are described in Water-Supply Paper No. 177, page 251.

Discharge measurements of North Fork of Umpqua River near Oakcreek, Oreg., in 1905–6

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
September 6	L. R. Allen	215	457	1.35	886
October 19	do	222	580	2.10	1,420
December 27	do	279	1,450	5.35	7,110
1906.					
January 31	L. R. Allen	280	1,480	5.56	7,370
March 20	do	249	847	3.23	2,780
May 1	do	268	1,090	4.06	4,340
May 30	do	284	1,800	6.74	10,200
July 14	do	213	611	2.23	1,600
August 10	do	190	508	1.73	1,120
September 13	do	208	604	2.30	1,610

Daily gage height, in feet, of North Fork of Umpqua River near Oakcreek, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.6	5.2	5.3	5.5	4.05	5.0	2.9	1.8	1.5	1.5	1.5	2.4
2	3.2	5.0	4.75	5.5	3.9	4.7	2.8	1.8	1.5	1.5	1.55	2.35
3	3.1	4.7	4.5	5.1	3.9	4.5	2.8	1.8	1.5	1.55	1.5	2.3
4	3.4	4.3	4.4	4.5	3.95	4.45	2.5	1.8	1.5	1.5	1.8	2.3
5	3.7	4.15	4.3	4.4	3.8	4.3	2.6	1.8	1.5	1.55	2.8	2.45
6	3.7	4.1	4.2	4.2	3.7	4.5	2.5	1.8	1.5	1.5	2.25	2.5
7	3.7	4.1	4.9	4.0	3.65	4.95	2.5	1.75	1.5	1.5	6.25	4.5
8	3.8	4.1	5.0	3.8	3.6	5.2	2.45	1.75	1.6	1.45	4.35	4.55
9	7.3	3.7	5.0	4.4	3.65	5.5	2.4	1.7	1.7	1.45	3.75	4.7
10	5.2	3.6	4.75	4.4	3.75	5.05	2.35	1.7	1.5	1.45	3.3	4.4
11	5.4	3.5	4.3	3.85	3.7	5.5	2.35	1.7	1.5	1.5	3.3	4.2
12	5.55	3.4	4.15	3.65	3.55	4.5	2.3	1.7	1.65	1.8	2.8	4.2
13	6.2	3.3	3.7	3.55	3.5	4.5	2.25	1.7	2.4	1.7	3.8	3.7
14	6.1	3.3	3.5	3.55	3.5	4.3	2.2	1.65	2.3	1.75	4.1	3.55
15	5.4	3.7	3.25	3.65	4.1	4.4	2.2	1.65	2.5	1.65	7.75	4.35
16	12.5	3.6	3.25	3.7	4.0	4.3	2.25	1.65	1.95	2.1	5.75	6.15
17	7.0	3.85	3.0	3.5	3.8	4.5	2.15	1.65	1.75	3.0	7.1	5.0
18	6.7	4.6	3.15	3.5	3.6	4.1	2.1	1.6	1.65	2.9	6.1	4.4
19	6.3	6.75	3.1	3.5	3.55	3.95	2.1	1.5	1.5	2.9	4.5	4.4
20	4.3	7.3	4.8	3.75	3.95	3.8	2.05	1.5	1.55	2.9	4.1	6.15
21	4.0	7.5	4.4	3.9	4.5	3.6	1.9	1.5	1.55	1.85	4.9	6.9
22	8.95	6.95	4.15	3.95	4.9	3.3	2.0	1.5	1.55	1.85	4.4	5.7
23	5.6	6.55	3.8	3.95	4.5	3.0	1.95	1.6	1.6	1.85	3.95	4.95
24	7.4	6.95	4.3	3.7	4.8	3.3	1.95	1.55	1.8	1.7	3.6	5.2
25	6.7	6.4	4.2	3.85	4.0	3.2	1.95	1.55	1.5	1.65	3.3	6.85
26	6.06	6.4	4.2	4.05	4.0	3.1	1.9	1.55	1.6	1.6	3.0	7.4
27	5.4	7.25	4.1	4.2	5.8	3.1	1.9	1.5	1.55	1.75	2.8	5.9
28	5.1	7.0	3.9	4.45	7.5	3.05	1.9	1.5	1.55	1.65	2.7	5.0
29	4.7	......	3.7	4.3	7.9	3.0	1.9	1.5	1.5	1.6	2.5	4.9
30	5.2	......	3.9	4.2	6.75	2.9	1.9	1.5	1.5	1.65	2.5	4.8
31	5.2	......	5.9	......	5.5	......	1.85	1.5	......	1.5	......	4.8

Rating table for North Fork of Umpqua River near Oakcreek, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.30	860	2.50	1,860	3.70	3,580	4.90	5,930	7.20	11,340
1.40	920	2.60	1,980	3.80	3,760	5.00	6,150	7.40	11,860
1.50	985	2.70	2,100	3.90	3,940	5.20	6,590	7.60	12,390
1.60	1,055	2.80	2,230	4.00	4,130	5.40	7,040	7.80	12,930
1.70	1,130	2.90	2,360	4.10	4,320	5.60	7,500	8.00	13,470
1.80	1,205	3.00	2,500	4.20	4,510	5.80	7,960	9.00	16,300
1.90	1,285	3.10	2,640	4.30	4,700	6.00	8,420	10.00	19,300
2.00	1,370	3.20	2,780	4.40	4,900	6.20	8,900	11.00	22,300
2.10	1,460	3.30	2,930	4.50	5,100	6.40	9,380	12.00	25,300
2.20	1,550	3.40	3,080	4.60	5,300	6.60	9,860		
2.30	1,650	3.50	3,240	4.70	5,510	6.80	10,340		
2.40	1,750	3.60	3,410	4.80	5,720	7.00	10,830		

NOTE.—The above table is applicable only for open-channel conditions. It is based on 10 discharge measurements made during 1905-6 and is well defined between gage heights 1.3 feet and 7.0 feet.

Monthly discharge of North Fork of Umpqua River near Oakcreek, Oreg., for 1905–6.

[Drainage area, 1,000 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
September 6–30	1,090	800	902	44,700	0.902	0.839
October	2,300	920	1,270	78,100	1.27	1.46
November	2,230	890	1,190	70,800	1.19	1.33
December	9,020	1,650	3,020	186,000	3.02	3.48
The period	....	....	....	380,000	....	....
1906.						
January	26,800	2,640	7,600	467,000	7.60	8.76
February	12,100	2,930	6,490	360,000	6.49	6.76
March	8,190	2,500	4,570	281,000	4.57	5.27
April	7,270	3,240	4,340	258,000	4.34	4.84
May	13,200	3,240	5,000	307,000	5.00	5.76
June	7,270	2,360	4,470	266,000	4.47	4.99
July	2,360	1,240	1,600	98,400	1.60	1.84
August	1,200	985	1,090	67,000	1.09	1.26
September	1,860	985	1,120	66,600	1.12	1.25
October	2,500	952	1,260	77,500	1.26	1.45
November	12,800	985	4,120	245,000	4.12	4.60
December	11,900	1,650	5,500	338,000	5.50	6.34
The year	26,800	952	3,930	2,850,000	3.93	53.12

Note.—Values for 1905 and 1906 are excellent.

SOUTH FORK OF UMPQUA RIVER NEAR BROCKWAY, OREG.

This station was established December 6, 1905, by L. R. Allen. It is located just below Winston's highway bridge, 3 miles east of Brockway, Oreg., and 3 miles below the mouth of Lookingglass Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 250.

Discharge measurements of South Fork of Umpqua River near Brockway, Oreg., in 1905–6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
December 28	L. R. Allen	302	1,620	4.16	3,000
1906.					
February 1	L. R. Allen	303	1,650	4.32	3,490
March 21	do	299	1,440	3.60	2,390
May 2	do	295	1,200	2.82	1,500
May 29	do	320	3,130	8.77	14,800
May 29	do	318	2,920	8.40	13,800
July 13	do	283	688	.95	442
August 9	do	276	481	.22	205
September 14	I. E. Oakes	284	642	.78	414

Daily gage height, in feet, of South Fork of Umpqua River near Brockway, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.4	4.35	6.25	5.9	3.0	5.1	1.65	0.4	0.05	0.25	0.3	1.25
2	3.6	4.1	5.55	5.35	2.8	4.4	1.55	.35	.05	.25	.3	1.15
3	3.25	4.0	5.05	4.9	2.75	4.1	1.55	.35	.05	.25	.35	1.35
4	3.0	3.75	5.0	4.7	2.65	4.1	1.4	.35	.05	.25	.4	1.2
5	3.15	3.5	4.75	4.45	2.6	3.9	1.3	.35	.05	.25	2.0	1.2
6	3.2	3.35	4.7	4.2	2.5	3.25	1.3	.35	.05	.25	2.1	1.25
7	3.15	3.2	4.6	4.0	2.45	3.25	1.2	.3	.05	.2	2.8	1.6
8	3.1	3.05	4.6	3.75	2.3	3.4	1.2	.25	.05	.2	3.1	4.0
9	4.7	2.95	4.5	3.7	2.25	3.95	1.1	.25	.05	.15	2.8	4.1
10	5.25	2.85	4.35	3.7	2.25	4.1	1.05	.25	.1	.15	2.6	4.4
11	4.5	2.75	4.2	3.45	2.25	4.1	1.05	.2	.15	.15	1.9	5.8
12	6.45	2.6	4.0	3.25	2.2	4.0	1.0	.2	.25	.2	1.65	5.0
13	8.2	2.55	3.75	3.1	2.1	3.8	.95	.2	.45	.3	1.45	4.1
14	6.75	2.5	3.55	2.9	2.1	3.55	.95	.2	.6	.35	1.35	3.5
15	6.6	3.0	3.35	2.9	2.7	3.3	.85	.15	.8	.35	1.1	3.5
16	18.1	3.0	3.2	2.9	3.6	3.3	.8	.15	.9	.35	4.35	5.25
17	9.9	3.05	3.05	2.8	3.4	3.3	.8	.15	.9	.45	3.95	4.65
18	7.4	3.65	2.9	2.7	3.15	3.1	.8	.1	.85	1.05	5.3	4.05
19	6.0	6.2	3.0	2.6	2.95	2.85	.75	.1	.75	1.00	4.2	4.0
20	5.35	9.05	3.1	2.55	2.7	2.65	.7	.05	.6	.95	3.6	4.4
21	4.4	10.7	3.5	2.55	2.55	2.5	.65	.05	.4	.75	3.1	4.4
22	4.45	10.3	3.95	2.65	2.75	2.4	.65	.05	.3	.75	3.95	3.9
23	4.65	8.3	4.15	2.75	3.4	2.25	.6	.05	.35	.65	3.6	3.5
24	6.65	8.0	4.0	2.8	3.2	2.15	.6	.05	.4	.65	3.1	3.35
25	6.3	7.3	4.0	2.8	3.0	2.05	.55	.05	.45	.5	2.75	3.6
26	5.8	7.25	4.05	2.8	3.0	1.9	.55	.05	.45	.45	2.3	6 55
27	5.1	8.5	4.05	2.75	3.4	1.9	.5	.05	.3	.45	2.05	5.8
28	4.75	7.3	3.8	3.2	3.7	1.9	.5	.05	.25	.4	1.75	4.85
29	4.4	....	3.6	3.3	9.1	1.85	.45	.05	.25	.4	1.65	4.3
30	4.15	....	3.45	3.15	7.4	1.75	.45	.05	.25	.35	1.4	3 95
31	4.4	....	4.25	....	6.0	....	.4	.05	....	.35	....	4.9

Rating table for South Fork of Umpqua River near Brockway, Oreg., for 1905–6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
0.00	160	1.20	544	2.40	1,210	4 20	3,210	9 00	15.600
0.10	182	1.30	585	2.50	1,280	4 40	3,540	10 00	18,760
0.20	206	1.40	627	2 60	1,360	4 60	3,890	11.00	21,980
0 30	232	1.50	670	2.70	1,440	4 80	4,260	12 00	25,280
0.40	260	1.60	715	2 80	1,520	5 00	4 650	13 00	28,600
0 50	290	1.70	765	2.90	1,610	5.20	5,060	14 00	32,000
0.60	321	1.80	820	3.00	1,700	5 40	5,500	15 00	35,400
0.70	354	1.90	880	3 20	1,900	5.60	5,960	16 00	38,900
0.80	389	2.00	940	3.40	2,110	5 80	6,440	17 00	42,400
0.90	426	2.10	1,005	3.60	2,340	6 00	6,940	18.00	46,000
1.00	465	2 20	1,070	3.80	2,610	7.00	9.610		
1.10	504	2.30	1,140	4 00	2,900	8.00	12,530		

NOTE.—The above table is applicable only to open-channel conditions. It is based on 9 discharge measurements made during 1905–6 and is well defined below gage height 9 feet.

Monthly discharge of South Fork of Umpqua River near Brockway, Oreg., for 1905-6

[Drainage area, 1,800 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft per sq. mile.	Depth in inches.
1905.						
December 6-31	7,190	484	1,480	76,300	0.822	0.79
1906.						
January	46,400	1,700	6,760	416,000	3.76	4.34
February	21,000	1,280	6,120	340,000	3.40	3.54
March	7,580	1,610	3,160	194,000	1.76	2.03
April	6,600	1,320	2,340	139,000	1.30	1.45
May	15,900	1,000	2,480	152,000	1.38	1.59
June	4,850	792	2,020	120,000	1.12	1.25
July	740	260	434	26,700	2.41	.28
August	260	171	200	12,300	.111	.13
September	426	171	250	14,900	.139	.16
October	484	194	272	16,700	.151	.17
November	5,280	232	1,470	87,500	.817	.91
December	8,380	524	3,010	185,000	1.67	1.93
The year	46,400	171	2,380	1,700,000	1.50	17.77

Note.—Values for 1905 and 1906 are rated as excellent.

ILLINOIS RIVER DRAINAGE BASIN.

ROGUE RIVER NEAR TOLO, OREG.[a]

This station was established August 30, 1905. It is located at Gold Ray, Oreg., 1½ miles below Tolo post-office, just below the Condor Water and Power Company's dam and bridge, and a short distance below the mouth of Stewart Creek. The conditions at this station and the bench marks are described in Water-Supply Paper No. 177, page 249.

Discharge measurements of Rogue River near Tolo, Oreg., in 1905-6.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1905.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
August 30	L. R. Allen	180	1,010	1.10	1,330
October 17	do	180	1,020	1.20	1,290
December 26	do	184	1,100	1.57	1,510
1906.					
January 29	L. R. Allen	188	1,270	2.51	2,980
March 19	do	190	1,230	2.33	2,630
April 30	do	192	1,470	3.24	4,570
May 31	do	200	1,500	3.72	5,300
July 12	do	184	1,100	1.64	1,600
September 12	I. E. Oakes	178	981	1.06	1,330

[a] Referred to in 1905 report as "Gold Ray."

Daily gage height, in feet, of Rogue River near Tolo, Oreg., for 1906.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	2.65	3.6	......	3.1	3.8	2.1	1.6	1.05	1.1	1.2	1.45
2	1.38	2.6	3.15	3.7	3.2	3.7	2.5	1.6	1.05	1.1	1.2	1.5
3	1.4	2.55	2.9	3.5	3.1	3.6	2.5	1.5	1.05	1.1	1.3	1.4
4	1.48	2.4	2.85	3.3	3.2	3.6	2.5	1.5	1.1	1.1	1.55	1.4
5	1.45	2.35	2.75	3.3	3.3	3.4	2.6	1.3	1.1	1.1	1.7	1.4
6	1.4	2.3	2.75	3.4	3.2	3.3	2.5	1.3	1.1	1.1	1.75	1.55
7	1.4	2.25	2.9	3.4	3.2	3.3	2.4	1.3	1.1	1.1	2.0	1.7
8	1.5	2.2	2.95	3.3	3.1	3.2	2.4	1.3	1.1	1.1	1.95	2.75
9	1.7	2.18	3.0	3.4	3.2	3.7	2.4	1.2	1.1	1.1	1.8	2.15
10	2.05	2.1	3.0	3.2	3.4	3.5	2.3	1.3	1.1	1.1	1.65	2.1
11	1.9	2.1	3.1	3.0	3.3	3.3	2.4	1.2	1.1	1.1	1.35	2.05
12	2.25	2.05	3.15	3.0	3.1	3.3	2.3	1.2	1.1	1.1	1.3	2.1
13	3.2	2.0	3.0	2.9	2.9	3.2	2.2	1.25	1.2	1.1	1.35	2.2
14	2.78	1.95	3.0	3.0	3.0	3.1	2.2	1.3	1.4	1.1	1.4	2.0
15	2.65	2.3	2.8	2.9	3.2	2.9	2.3	1.2	1.5	1.2	1.45	2.2
16	11.4	2.25	2.7	3.1	2.9	3.0	2.3	1.25	1.45	1.35	2.1	2.7
17	4.4	2.25	2.6	2.9	3.0	2.9	2.2	1.2	1.25	1.5	2.15	2.25
18	4.0	2.82	2.5	2.9	2.8	2.8	2.2	1.2	1.2	1.5	2.05	2.15
19	3.5	4.5	2.4	3.0	2.7	2.8	2.1	1.2	1.2	1.35	1.7	2.2
20	2.8	4.4	2.5	3.2	......	2.75	2.1	1.2	1.2	1.2	1.5	2.45
21	2.4	4.7	2.8	3.4	2.7	2.7	2.2	1.2	1.2	1.2	1.65	2.4
22	2.25	4.5	3.1	......	3.0	2.6	2.1	1.2	1.15	1.2	1.7	2.2
23	3.75	4.4	2.8	3.5	2.9	2.5	2.0	1.2	1.1	1.2	1.55	2.25
24	3.85	4.0	2.7	3.3	2.7	2.4	2.0	1.2	1.1	1.25	1.4	2.4
25	3.7	3.7	3.0	3.4	2.6	2.3	2.0	1.2	1.1	1.3	1.4	3.5
26	3.25	3.8	3.5	3.0	2.7	2.35	1.9	1.2	1.1	1.35	1.35	4.75
27	2.95	4.6	3.1	3.2	......	2.4	1.9	1.2	1.1	1.3	1.4	3.4
28	2.75	3.9	3.0	3.3	3.8	2.3	1.7	1.2	1.1	1.2	1.35	2.95
29	2.55	......	2.8	3.2	4.7	2.3	1.8	1.2	1.1	1.2	1.35	2.95
30	2.5	......	2.9	3.1	4.4	2.2	1.7	1.05	1.1	1.2	1.35	3.15
31	2.7	......	5.1	......	3.9	......	1.7	1.1	......	1.2	......	2.9

Rating table for Rogue River near Tolo, Oreg., for 1905-6.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	1,200	2.00	2,100	3.00	3,830	4.00	6,000	6.00	11,320
1.10	1,270	2.10	2,300	3.10	4,030	4.20	6,480	6.20	11,900
1.20	1,340	2.20	2,450	3.20	4,230	4.40	6,980	6.40	12,480
1.30	1,420	2.30	2,600	3.30	4,440	4.60	7,490	6.60	13,060
1.40	1,500	2.40	2,760	3.40	4,650	4.80	8,010	6.80	13,660
1.50	1,590	2.50	2,930	3.50	4,870	5.00	8,540	7.00	14,260
1.60	1,690	2.60	3,100	3.60	5,090	5.20	9,080	8.00	17,280
1.70	1,800	2.70	3,280	3.70	5,310	5.40	9,620	9.00	20,500
1.80	1,910	2.80	3,460	3.80	5,540	5.60	10,180	10.00	23,850
1.90	2,030	2.90	3,640	3.90	5,770	5.80	10,740	11.00	27,300

NOTE.—The above table is applicable only for open-channel conditions. It is based on 8 discharge measurements made during 1905-6 and is fairly well defined below gage height 4 feet.

Monthly discharge of Rogue River near Tolo, Oreg., for 1905–1906.

[Drainage area, 2,020 square miles.]

Month.	Discharge in second-feet.			Total in acre-feet.	Run-off.	
	Maximum.	Minimum.	Mean.		Sec.-ft. per sq. mile.	Depth in inches.
1905.						
September	1,600	1,240	1,300	77,400	0.644	0.72
October	1,600	1,300	1,390	85,500	.688	.79
November	1,500	1,340	1,370	81,500	.678	.76
December	1,930	1,320	1,490	91,600	.738	.85
The period	....	....	....	336,000	....	....
1906.						
January	27,800	1,480	4,000	246,000	1.98	2.28
February	7,750	2,000	4,040	224,000	2.00	2.08
March	8,810	2,700	3,840	236,000	1.90	2.19
April	7,060	3,640	4,370	260,000	2.16	2.41
May	7,750	3,100	4,220	259,000	2.09	2.41
June	5,540	2,450	3,840	228,000	1.90	2.12
July	3,100	1,800	2,440	150,000	1.21	1.40
August	1,690	1,230	1,390	85,500	.688	.79
September	1,500	1,230	1,310	78,000	.648	.72
October	1,590	1,270	1,340	82,400	.663	.76
November	2,380	1,340	1,680	100,000	.832	.93
December	7,880	1,500	2,820	173,000	1.40	1.61
The year	27,800	1,230	2,940	2,120,000	1.46	19.70

NOTE.—Discharges have been interpolated for days when gage was not read. Values for 1905-1906 are rated good.

ROGUE RIVER NEAR GALICE, OREG.

This station was established May 29, 1906. It is located at the ferry on the Mertin-Galice road in sec., 9, T. 35 S., R. 7 W. The gage is an inclined staff on the left bank.

Gage heights, discharge measurements, and monthly discharges have been furnished by Charles Gilman Hyde, University of California, Berkeley, Cal.

Discharge measurements of Rogue River near Galice, Oreg., in 1906.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
May 16	C. G. Hyde	6.5	4,170
August 6	do	4.5	1,400

Daily gage height of Rogue River at Galice, Oregon, for 1906.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	7.5	5.6	4.5	4.35	4.4	4.35	4.6
2	....	7.4	5.5	4.5	4.35	4.4	4.4	4.6
3	....	7.3	5.5	4.5	4.35	4.4	4.5	4.5
4	....	7.6	5.4	4.5	4.35	4.4	4.6	4.5
5	....	7.4	5.4	4.5	4.35	4.4	4.85	4.6
6	....	7.1	5.3	4.5	4.35	4.35	4.75	5.3
7	....	7.2	5.3	4.5	4.3	4.35	4.65	5.8
8	....	7.1	5.2	4.5	4.25	4.35	5.8	6.3
9	....	7.7	5.15	4.5	4.4	4.3	5.0	6.1
0	....	7.5	5.05	4.4	4.5	4.35	4.8	5.0
1	....	7.3	5.0	4.4	4.4	4.35	4.8	5.8
2	....	7.5	5.0	4.4	4.35	4.35	4.8	5.6
13	....	7.2	4.9	4.4	4.5	4.35	4.75	5.5
14	....	7.0	4.9	4.4	4.7	4.35	4.75	5.4
15	....	6.8	4.9	4.4	4.6	4.4	5.0	5.8
16	....	7.2	4.9	4.4	4.5	4.4	5.85	6.8
17	....	6.9	4.8	4.4	4.5	4.5	5.85	5.2
18	....	5.7	4.8	4.4	4.5	4.5	5.8	5.7
19	....	6.5	4.8	4.4	4.4	4.5	5.5	5.5
20	....	5.4	4.7	4.4	4.4	4.5	5.0	5.7
21	....	6.3	4.7	4.4	4.5	4.5	5.0	6.0
22	....	6.2	4.7	4.4	4.5	4.5	5.2	5.7
23	....	5.1	4.7	4.4	4.4	4.45	5.0	5.6
24	....	6.1	4.7	4.4	4.4	4.45	5.0	5.6
25	....	5.0	4.6	4.4	4.4	4.45	4.9	6.7
26	....	5.9	4.6	4.4	4.4	4.4	4.9	9.8
27	....	5.9	4.6	4.4	4.4	4.4	4.8	8.1
28	....	5.8	4.5	4.4	4.4	4.4	4.7	7.0
29	9.0	5.7	4.5	4.4	4.3	4.35	4.7	6.8
30	8.6	5.6	4.5	4.4	4.3	4.35	4.6	7.5
31	8.5	....	4.5	4.4	....	4.35	....	7.0

Monthly discharge of Rogue River near Galice, Oreg., in 1906.

Month.	Discharge in second-feet.			Total in acre-feet.
	Maximum	Minimum.	Mean.	
June	6,250	2,700	4,700	280,000
July	2,700	1,400	1,800	111,000
August	1,400	1,350	1,360	83,600
September	1,600	1,225	1,350	80,300
October	1,400	1,300	1,350	83,000
November	3,125	1,300	1,850	110,000
December	9,950	1,400	3,350	206,000
The period	....	....	....	954,000

NEHALEM RIVER DRAINAGE BASIN.

NEHALEM RIVER AT FISHHAWK, OREG.

This station is located at Fishhawk post-office, below the mouth of Fishhawk Creek. The bed of the stream is of clean sand, liable to shift. Measurements are made from a cable and car. The gage rod is a 2 by 8 inch timber in four sections. The bench mark is the top of three spikes driven in the upper side of a cedar stump about 50 feet above the cable on the left bank; elevation, 23.69 feet above the datum of the gage. No gage heights were observed during 1906.

Discharge measurements of Nehalem River at Fishhawk, Oreg., in 1906.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharg
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-f.*
April 18	L. R. Allen	59	316	1.02	[illegible]
April 19	do	59	203	.93	[illegible]
May 21	do	59	284	.52	[illegible]
August 1	do	55	179	.24	[illegible]

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous measurements were made in North Pacific Ocean drainage in 1906:

Miscellaneous measurements in North Pacific Ocean drainage in 1906.

Date.	Stream.	Locality.	Width.	Area of section.	Discharg
			Feet.	*Sq. ft.*	*Sec.-ft.*
August 5	Antelope Creek	Eagle Point			0
August 8	Applegate Creek	Ruch	41	86	110
August 5	Big Butte Creek	Sec. 14, T. 34 S., R. 1 E.	102	291	184
August 6	Condor Water and Power Co.'s canal.	Prospect, 200 feet below dam.	14	36	74
August 7	Elk Creek	Sec. 31, T. 33 S., R. 1 W.	25	20	9.1
August 5	Little Butte Creek	Eagle Point	36	42	48
August 6	Rogue River	Prospect, below dam	53	289	445
August 13	Siuslaw River	Below Walton Creek, sec. 16, T. 18 S., R. 8 W.	107	127	131
August 7	Trail Creek	Mouth			0

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1889. Eleventh Annual Report, Part II*.
1890. Twelfth Annual Report, Part II*.
1891. Thirteenth Annual Report, Part III*.
1892. Fourteenth Annual Report, Part II*.
1893. Bulletin No. 131*.
1894. Bulletin No. 131*; Sixteenth Annual Report, Part II*.
1895. Bulletin No. 140*.
1896. Water-Supply Paper No. 11*; Eighteenth Annual Report, Part IV*.
1897. Water-Supply Papers Nos. 15* and 16*; Nineteenth Annual Report, Part IV*.
1898. Water-Supply Papers Nos. 27* and 28*; Twentieth Annual Report, Part IV*.
1899. Water-Supply Papers Nos. 35*, 36*, 37*, 38*, and 39*, Twenty-first Annual Report, Part IV*.
1900. Water-Supply Papers Nos. 47, 48, 49, 50, 51, and 52; Twenty-second Annual Report, Part IV.
1901. East of Mississippi River, Water-Supply Papers Nos. 65* and 75*.
West of Mississippi River, Water-Supply Papers Nos. 66 and 75*.

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Series
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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

GEOLOGY AND WATER RESOURCES

OF A PORTION OF THE

MISSOURI RIVER VALLEY IN NORTHEASTERN NEBRASKA

BY

G. E. CONDRA

WASHINGTON
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1908

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GEOLOGY AND WATER RESOURCES OF A PORTION OF THE MISSOURI RIVER VALLEY IN NORTHEASTERN NEBRASKA.

By G. E. Condra.

INTRODUCTION.

The region considered in this report lies in northeastern Nebraska, south of Missouri River, and extends about 150 miles east and west and approximately 29 miles north and south. The total area is over 4,100 square miles, comprising Dakota, Cedar, Knox, and Boyd counties and the northern part of Holt County, as shown in Pl. I.

The eastern part of the area was settled long ago, and the western counties are now rapidly filling up. The entire region has a fertile soil, and there is sufficient rainfall to insure crops in most seasons, especially where careful cultivation is practiced. Very little irrigation is needed, and a few short ditches constructed during exceptionally dry years are not used at present. In 1903 no irrigation whatever was employed.

Stock raising is carried on extensively where the land is not farmed. There is an abundance of ground water throughout most of the area, yet at places in Boyd, Knox, and Holt counties there is difficulty in obtaining a sufficient supply of good well water for stock and domestic purposes. On this account considerable space is given in this report to ground water and shallow wells in those counties.

Many springs, some of them of good volume, are found in every county. Artesian wells are obtained on the Missouri bottom and adjacent lowlands from eastern Boyd to the northeastern part of Dixon County.

This report is a result of studies made in the field during the summer of 1903, under the direction of N. H. Darton. There was found to be much local interest in cement rock, coal, and the water conditions. Special trips were made into Dixon and Dakota counties with Prof. J. E. Todd, who has furnished important suggestions as to the geology and has supplied several sections. It was found necessary to determine the broader structural and stratigraphic relations of the Cretaceous formations, and, in order to do this, observations were continued into Iowa and South Dakota.

Only about 250 square miles of the area have been topographically surveyed and these are included in the Elk Point quadrangle, which extends from South Dakota into Dixon and Dakota counties. Outside of that area altitudes were obtained from railroad levels and by the use of an aneroid barometer.

TOPOGRAPHY.

The principal topographic features of the region are the result of the erosive action of streams, but glacial action has modified the surface in some districts by changing the preglacial drainage and adding deposits of gravel, sand, bowlders, and clay, while the wind has modified certain sandy surfaces into small areas of dunes. The altitude varies from over 2,100 feet on the table-lands of western Holt and Boyd counties to about 1,100 feet on the lowlands of Dakota County. The Missouri River, which is the principal stream, has eroded a trough, usually with steep slopes, to an average depth of 500 to 600 feet below the general upland level. The entire area slopes gradually downward from west to east, and more steeply northward from the high divides toward Missouri River. While most of the area slopes and drains northward toward that river, the drainage of small portions of Holt, Knox, Cedar, Dixon, and Dakota counties flows southeastward and reaches the river farther south.

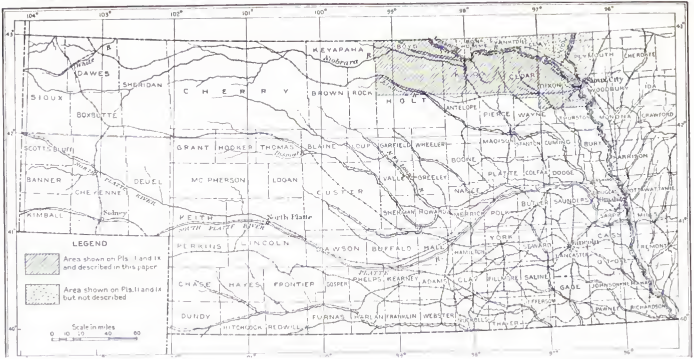
DESCRIPTIVE GEOLOGY.

STRATIGRAPHY.

Study of the local geology of a region affords information concerning the soil, aids in drilling artesian wells by indicating the thickness and character of the formations through which the drill must pass, and is a guide to many natural resources which may be advantageously developed.

The formations in this area are all of sedimentary origin and belong to the Cretaceous, Tertiary, and Quaternary systems. The Cretaceous strata, which are the lowest exposed, consist of beds wide in extent and nearly horizontal in position or with a slight dip to the west. They are composed of clay, chalk, limestone, and sandstone, which were for the greater part marine accumulations of mud, minute calcareous shells, and sand. These formations outcrop extensively along Missouri River and other streams, as shown in Pl. II (in pocket), and by well records their relations at other places are known. The total thickness of the Cretaceous beds in the western part of Boyd County is thought to be about 1,400 feet. From records of deep borings at Ponca and Sioux City it is known that the Carboniferous limestones also underlie the region, beginning at a depth of about 545 feet Ponca, Nebr., and 335 feet at Sioux City, Iowa.

Google


LEGEND
Area shown on Pls. I and IX and described in this paper
Area shown on Pls. II and IX but not described
Scale in miles
0 10 20 40 60
104°
103°
102°
101°
100°
99°
98°
97°
96°
43°
42°
41°
40°
White R.
DAWES
SIOUX
SHERIDAN
BOXBUTTE
CHERRY
KEYAPAHA
Niobrara R.
BROWN
ROCK
BOYD
HOLT
KNOX
CEDAR
DIXON
BON HOMME
YANKTON
CLAY
PLYMOUTH
CHEROKEE
Sioux City
WOODBURY
IDA
DAKOTA
ANTELOPE
PIERCE
WAYNE
THURSTON
MONONA
CRAWFORD
SCOTTS BLUFF
GRANT
HOOKER
THOMAS
Dismal
BLAINE
LOUP
GARFIELD
WHEELER
MADISON
STANTON
CUMING
BURT
HARRISON
BANNER
DEUEL
MC PHERSON
LOGAN
BOONE
PLATTE
COLFAX
DODGE
CHEYENNE
NORTH PLATTE RIVER
VALLEY
GREELEY
CUSTER
NANCE
WASHINGTON
POTTAWATTAMIE
KIMBALL
Sidney
KEITH
North Platte
SOUTH PLATTE RIVER
SHERMAN
HOWARD
MERRICK
POLK
BUTLER
SAUNDERS
DOUGLAS
Omaha
SARPY
MILLS
PERKINS
LINCOLN
DAWSON
BUFFALO
HALL
HAMILTON
YORK
SEWARD
Lincoln
LANCASTER
CASS
OTOE
FREMONT
CHASE
HAYES
FRONTIER
GOSPER
PHELPS
KEARNEY
PLATTE R.
ADAMS
CLAY
FILLMORE
SALINE
GAGE
JOHNSON
NEMAHA
DUNDY
HITCHCOCK
REDWILLOW
FURNAS
HARLAN
FRANKLIN
WEBSTER
NUCKOLLS
THAYER
JEFFERSON
PAWNEE
RICHARDSON

The following sections represent the succession at certain typical localities:

Section below the mouth of Aowa Creek, Dixon County, Nebr.

	Feet.
Loess, extends 98 feet higher in slope; exposed	7–36
Glacial till	22
Greenhorn limestone:	
Limestone, slabby, with many remains of *Inoceramus labiatus*	5½
Clay, dark, sandy, with some chalk	1
Limestone, slabby, containing *Inocerami*	4
Limestone, bluish, chalky, weathers to a light color resembling Niobrara chalk rock; contains some *Inocerami*	9
Graneros shale:	
Clay, bluish and somewhat chalky above, dark below, contains iron pyrites concretions, and sulphate of iron as a powder	49½
Clay, dark, at places carbonaceous above, usually sandy, containing concretions of iron pyrites and marcasite and rosettes of selenite	7
Dakota sandstone:	
Sandstone, light to rusty color, porous, and soft; with root marks. Rusty iron concretions occur near the center and base. The beds thicken and dip westward	7–10
Clay, dark, contains irregular streaks of light-colored sand	2½
Sandstone, nodular, contains rusty iron, limy at places	¾
Shale and nodules, dark, very sandy near ravine	1
Sandstone, with layers of concretionary iron between beds	4½
Sandstone, rusty and dark, varying from sandstone to shale	5½–6
Sandstone, rusty, porous at 1,120 feet above sea level	

The beds show a steeper westward inclination near the mouth of Aowa Creek, beyond which they appear to rise again for a short distance.

Combined section from Vermilion Ferry to the Dixon-Cedar county line.

No.		Feet.
7.	Loess; thick on higher slopes.	
6.	Glacial drift; usually covered by loess	0–3
5.	Niobrara chalk rock, light color, soft, rises in hills above, exposed in three banks	1–5
4.	Clay, dark, with some selenite crystals, sandy at places	13
3.	Sandstone and clay, varies from sandstone to plastic clay. Beds carbonaceous at places	8
2.	Clay, bluish or dark, plastic, covered with many selenite crystals. Contains two zones of calcareous concretions, one 63–65 feet and the other 55 feet above the river. In one bank a thin bed of rusty sandstone is found 10 feet above the river	73
1.	Shale, dark blue, chalky, containing *Serpula*, large, flat *Inocerami*, *Ostrea congesta*, and *Prionocyclus*. Exposed above water	3–4
	Altitude of top of No. 1, at ferry	1,130
	Altitude of base of No. 5	1,224
	All below No. 5 are included in the Carlile shale of the Benton group.	

On the eroded upper surface of the Cretaceous lie sheets of sand and clay of Tertiary age, which are thickest and most typically developed in the western parts of Boyd and Holt counties, and thin out in Knox and Cedar counties. The only portion of the Tertiary thus far identified here is the Arikaree formation and an unnamed formation of Pliocene age. A more careful examination of the western part of the region may possibly show the presence of outliers of the White River formation below the Arikaree.

Lying on the eroded surface of the Cretaceous and Tertiary formations, over wide areas, are the deposits of clay, sand, gravel, bowlders, loess, and alluvium of Quaternary age.

STRUCTURE.

In outcrops in northeastern Nebraska the rocks usually appear to lie horizontal, but they have a slight general inclination to the west or west-northwest, which becomes very low for some distance above the mouth of Niobrara River. The principal structural features are shown on the cross sections Pl. III (in pocket). The westerly dip is indicated by the differences in altitude of the top of the Dakota sandstone, which slopes from a height of 40 feet above the river level, or altitude of 1,160 feet, at Sioux City to a depth of 500 feet, or altitude of about 720 feet, at Niobrara. This difference of 440 feet in 80 miles indicates an average dip of 5½ feet to the mile. The dip from Sioux City to Ponca, however, is slight, making the average dip from Ponca to Niobrara about 7 feet to the mile. At Lynch, 23 miles west of Niobrara, the altitude of the top of the formation is about 690 feet, which indicates a fall of only about 1 foot to the mile in that direction, while to the northwest, up the Missouri valley, there is a similar low dip.

DESCRIPTION OF THE ROCKS.

CRETACEOUS SYSTEM.

DAKOTA SANDSTONE.

The Dakota sandstone is of considerable economic importance, furnishing artesian water, brick clay, fair building stone in places, and small amounts of a poor grade of lignite coal.

It outcrops occasionally in bluffs in southeastern Dakota County, Nebr., at Sioux City, Iowa, and along Big Sioux River in Iowa. In Nebraska the formation outcrops at intervals from the high hills southeast of Homer to a point northeast of Ponca, where it passes beneath the river level. It extends far to the northwest and the southwest under later formations and comes to the surface in the Black Hills and the Rocky Mountains. According to well records, its upper surface lies at a depth of 360 feet at Aten, 600 feet at Santee, 500 feet at Niobrara, and 700 feet at Lynch.

The formation is penetrated by wells at Ponca, Nebr., and Sioux City, Iowa, where in each case the thickness is thought to be between

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300 and 400 feet. In the Ponca well, 700 feet deep, the base of the formation appears to be at an altitude of about 755 feet, while its upper surface, exposed in bluffs east of the town, rises to 1,135 feet, indicating a thickness of 380 feet; but this estimate probably is somewhat too large.

According to Professor Todd the mouth of the Sioux City well is 38 feet below the outcrops of the sandstone, whose altitude is 1,122 feet, and, as the bottom of this sandstone, according to the well record, is at an altitude of 825 feet, the thickness is 335. It is thought, however, that the beds observed near the mouth of the well are not at the top of the formation and that some higher strata have been removed by erosion.

The Dakota formation is composed largely of thick deposits of coarse friable sandstone, light buff to rusty in color, with interbedded clay beds of different colors, mostly blue, gray, and yellow. One thick bed of clay north of Sioux City overlies the massive cross-bedded sandstone which outcrops along the river banks in that vicinity. Numerous iron-oxide concretions abound in the clay, as do also thin beds of sandstone merging into irregular, sandy iron-oxide deposits of variable thickness. Lignite, in thin irregular beds, occurs in the upper part of the formation, and also at lower levels near Jackson and Homer. Many well-preserved leaves are found which have been studied and described by various paleontologists.

The component beds of the Dakota formation in this region are not sufficiently continuous, extensive, nor distinctive to afford a basis for subdividing the formation into different horizons, yet in the outcrop area the following order has been observed, passing downward: (1) Porous sandstone with root marks, interstratified clays, and shale or lignite beds; (2) clay, thin sandstone, and concretionary ironstone beds; (3) massive, cross-bedded sandstone with thin beds of clay.

As the sandstones weather more slowly than the clay beds they often form bluffs (see Pl. IV, *A*), which extend as a more or less continuous escarpment from southeastern Dakota County to a point near Ponca. At cut banks along the river and near the mouths of a few ravines these bluffs form prominent points and buttresses. The topography varies somewhat, the massive sandstone giving sharp outlines and the clay more gradual slopes. Loess and Graneros clay often slide down over these outcrops, concealing the beds.

Section of Dakota sandstone 5 miles southeast of Homer, Nebr.

	Feet.
Thin beds of sandstone and clay, colored by iron	18
Sandstone, massive, cross-bedded. These beds vary much in texture; within a few feet they may grade from sand into sandstone and even quartzite. The colors are light gray, rusty, and dark	19

Section of Dakota sandstone and overlying loess at the quarry just northwest of Homer, Nebr.

	Feet.
Loess at top of bluff	12
Clay, shaly and oxidized to a yellowish color	2
Sandstone, light colored, porous, massive, not cross-bedded	7
Clay, light colored, concretionary	2
Sandstone, much like No. 6 but with root marks in upper part	10
Clay, light colored, sandy, oxidized; yellowish at places, with hard layers of concretionary iron 1 to 12 inches thick	28
Clay, yellowish, with fewer iron concretions than in No. 3	5
Sandstone, light colored to rusty, massive, cross-bedded, interstratified with thin layers of clay	20

In the Ashford well just west of Homer, the lowest bed of the above section was not penetrated at a level fully 70 feet lower. This member of the Dakota formation rises high in the bluffs some 6 or 7 miles southeast of Homer.

Section of Dakota sandstone and glacial clay in the quarry at Jackson, Dakota County, Nebr.

	Feet.
Glacial clay with some sand	3
Sandstone, rusty	½-1
Sandstone, light colored, loosely cemented	2
Sandstone, rusty to light colored, friable, in beds 2 to 8 inches thick with thin layers of light-colored clay between	8
Clay, sandy, light colored	½
Sandstone, light colored, friable	1½
Sandstone, clay or sand, varying; color rusty to light	3

Parts of the stone in this quarry are used for building purposes. Several good specimens of leaves were found here. According to the report of the well drillers a thin bed of impure coal lies 30 feet below the lowest point in the quarry.

Record of Mattison's well, N.E. ¼ S.W. ¼ sec. 20, T. 31 N., R. 6 E., southeast of Ionia, Nebr.

	Feet.
Shaly limestone	0- 8
Chalk	8- 12
Dark shale	12- 45
Blue clay	45-105
Soft sandstone	105-277
Sand and gravel	277-302
Clay or shale	302-312
Soft sandstone	312-487
Gravel	487-517

BENTON GROUP.

The Benton group lies between the Dakota and Niobrara formations and, as Mr. Darton has shown, is separable in this region into three distinct formations, which represent the Graneros shale, the Green-

A. DAKOTA SANDSTONE ON BANK OF MISSOURI RIVER BELOW MOUTH OF AOWA CREEK.

B. GREENHORN LIMESTONE ON GRANEROS SHALE NORTHEAST OF PONCA, NEBR.

horn limestone, and the Carlile formation of eastern Colorado and the Black Hills.

Graneros shale.—The best exposures of the Graneros shale are in river bluffs below the mouth of the Aowa Creek, above Ponca Landing, and at the Bigley Ravine, near Ponca. The shale lies on the Dakota sandstone and is overlain by the Greenhorn limestone. It occurs high in the slopes in Dakota County, and dips gradually to the northwest, its base reaching the level of the river about 3 miles north of Ponca. The thickness in Dixon County is from 50 to 60 feet, while in the Black Hills it varies from 800 to 900 feet. According to Mr. Burchard[a] it appears to thin out and disappear southeast of Homer, where the Greenhorn limestone lies very close to if not directly on the Dakota sandstone. It is composed principally of very dark gray to bluish-gray clay or soft shale which grades above and below into harder shale. The section at the mouth of Aowa Creek (p. 7) shows the usual relations.

Greenhorn limestone.—This medial member of the Benton group lies from 50 to 60 feet above the Dakota sandstone and is 18 to 20 feet thick, not including a few feet of shaly transition beds above and below. The principal rock is fossiliferous limestone with an admixture of clay and some sand. The upper beds are slabby, highly fossiliferous, and stained with iron, while the lower beds are more massive and chalky and contain a smaller number of large fossils. The formation is characterized by very numerous casts of *Inoceramus labiatus* (see Pl. VI). This limestone was traced from high in the hills of southeastern Dakota County to the river level in the Ionia section northeast of Newcastle.

Pl. IV, *B* shows a characteristic outcrop of this limestone. These beds weather out like chalk and were formerly mistaken for the Niobrara chalk rock, which, however, occurs at a higher level farther west.

Section of Greenhorn limestone and associated beds in cut bank and slide three-fourths mile northwest of Ponca Landing, Nebr.

	Feet.
Loess and till	80
Greenhorn limestone:	
Limestone, weathered, sandy; contains many casts of *Inoceramus labiatus*	8–9
Limestone, bluish gray, massive, chalky	10
Graneros shale:	
Clay, bluish, stratified	20
Clay, dark or bluish, at places rusty	25–30
Shale, dark, quite hard	2

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[a] Geology of Dakota County, Nebr.: Proc. Acad. Sci. of Sioux City, Iowa, 1903–4, vol. 1, p. 150.

Carlile shale.—This uppermost division of the Benton group begins to appear above the Greenhorn limestone in eastern Dixon County and thickens westward to 170 feet in northwestern Dixon County to over 200 feet at Niobrara, and to 500 to 700 feet in the Black Hills. In the eastern part of its outcrop area it erodes rapidly, forming slopes over which loess and Glacial drift slide from above, concealing it at many points in the bluffs of Dixon County. The base of the formation reaches the level of the river just west of the so-called Ionia Volcano, northwest of Newcastle. The upper surface is about 140 feet above the river level in sec. 28, T. 32, R. 4 E., 97 feet above at Vermilion Ferry, 71 feet above northeast of St. James, 30 feet above north of St. Helena, and reaches the level of the river about 4 miles beyond the last-named town. Recent slides northeast of Ponca expose 8 to 12 feet of Carlile above Greenhorn limestone in the vicinity of the ferry. A well-marked line of contact with the Niobrara chalk above is shown in Pl. V, *A*.

The formation is composed principally of dark-gray and bluish-gray stratified clays, with two zones of fossiliferous chalky shale. Sandstone beds of variable extent and character generally occur at different levels, but usually near the top, as just west of Vermilion Ferry. Large concretions of carbonate of lime are found above the middle of the formation. Drillers in penetrating this formation experience difficulty with the hard concretions and sandstone and with the thin layers of iron pyrites which also often occur in it. Many fish-scales, a large, flat form of *Inoceramus*, *Prionocyclus*, *Serpula*, and *Ostrea congesta* are common fossils.

A locality in northern Dixon County, in sec. 10, T. 31, R. 5 E., has received the name Ionia Volcano. It is simply a bluff of shale in which the oxidation of a large amount of iron pyrites often produces considerable heat, at times sufficient to give rise to steam and sulphur fumes, and even to cause slight baking of the shale.

Two zones of concretions of carbonate of lime occur in the Carlile shale. The lower zone is a continuous one, and its concretions are large, lens-shaped forms, 2 to 8 feet long and 1 foot or more thick (Pl. V, *B*). This horizon continues at about 50 feet from the top of the formation from high in the slope in sec. 32, T. 32, R. 5 E., to a point between St. James and St. Helena, where the dip takes it down to the level of the Missouri. The upper zone consists of smaller concretions at a less continuous horizon 8 to 10 feet above the first. These concretions weather out and fall to the base of a slope, where they crack into irregular pieces. In many of them calcite and selenite crystals occur.

While selenite crystals may be observed throughout the Graneros, Carlile, Niobrara, and Pierre, they are most abundant on slopes of the Carlile formation, especially at the Ionia Volcano or on other

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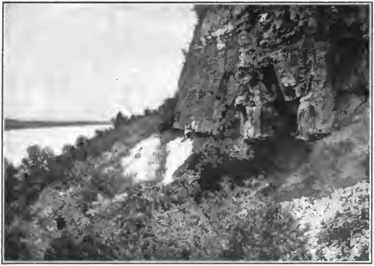
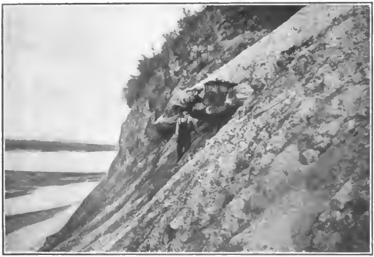


A. CARLILE SHALE OVERLAIN BY NIOBRARA NORTHEAST OF JAMES, NEBR.



B. CALCAREOUS CONCRETIONS IN CARLILE FORMATION WEST OF VERMILION FERRY, NEBR.

bluffs in that region, where they are commonly mistaken for mica. They vary in size from minute needles to 2 to 3 inches across. They originate near the surface from the weathering of the iron pyrites scattered through the clay, some of the products of which react with lime in solution in percolating waters, forming calcium sulphate which crystallizes as selenite. The usual belief that they were formed when the strata were deposited and that they occur in large numbers throughout the beds is therefore erroneous.

Section of Carlile shale and associated formations at the Ionia Volcano, in northern Dixon County, Nebr.

	Feet.
Loess and till	15-35
Clay (Carlile), dark, plastic. Contains sulphate of iron, epsom salts, selenite crystals, etc., over the surface. Sulphur dioxide fumes rise from the clay at one point	112
Shale, bluish	15
Limestone, slabby, with fish scales and *Inoceramus labiatus*	1½

Altitude of river, 1,118 feet; of top of hill, 1,265 feet.

The lowest bed is a part of the Greenhorn, while the overlying bluish shale is a transition to the base of the Carlile. It is prominently represented in a ravine below the old landing about 1 mile away.

Professor Todd has noted the existence of a thin but very persistent layer of clay closely resembling bentonite near the middle of the Carlile formation. It varies from 1½ to 3 inches thick. At Vermilion Ferry it is about 10 feet above the river. At the Ionia Volcano it is about 100 feet above the top of the Greenhorn beds, and it is at same horizon in ravines in the SW. ¼ sec. 26, T. 31 N., R. 5 E., and in a shaft in the SW. ¼ sec. 24 of the same township. It is suggested that it may originally have been a thin stratum of volcanic ash.

NIOBRARA FORMATION.

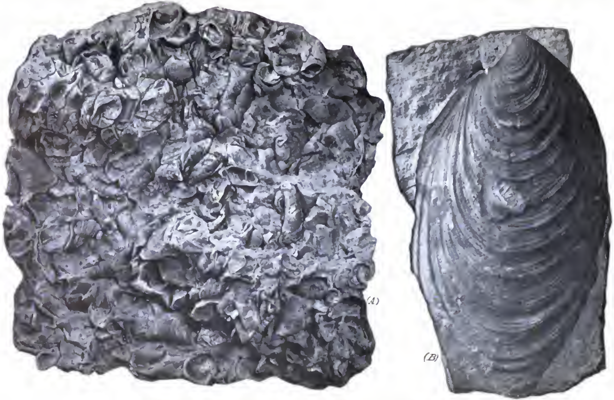
The Niobrara formation lies between the Carlile and the Pierre shales and is a conspicuous and characteristic feature of the region. It outcrops in the creek slopes of northwestern Dixon County, high in the river bluffs just west of Vermilion Ferry, and thence westward and northward along Missouri River and its tributaries to the great bend of that river in South Dakota. A thickness of about 130 feet remains in the hills northeast of St. James, Nebr., while westward at the margin of the Pierre shale the total thickness is over 200 feet. The easternmost points at which the formation is exposed or found in wells are in the SE. ¼ SW. ¼ sec. 32, T. 32 N., R. 5 E., and the W. ½ sec. 6, T. 29 N., R. 5 E. The dip, which is westerly, is low from St. James to Niobrara, beyond which the upper surface seems to be nearly level with perhaps a slight rise in the direction of Chamberlain, S. Dak. The base of the formation is 97 feet above the river near Vermilion Ferry, 71 feet northeast of St. James, and 30 feet at St. Helena, a few miles beyond which it passes below the level of the river. At the cement works west of Yankton, S. Dak., the upper surface is fully 140 feet above the river surface, while the base lies a few feet below it.

The formation is composed of lead-gray chalk rock, which weathers yellowish, with a variable admixture of clay and sand. Thin limestone beds composed of small *Ostrea congesta*, found principally in the upper portion, are a characteristic feature (see Pl. VI). In Cedar County and apparently at Niobrara, Knox County, the base of the formation is a sandy, hard limestone. The purer chalk beds vary from less than 1 inch to as much as 6 feet in thickness and merge into mixtures of chalk and clay in variable proportions. The upper surface is usually weathered, leaving a relatively larger percentage of clay, iron, and sand than is found in the more massive beds below. In the latter there are nearly vertical joint planes intersecting each other at angles of about 90 degrees. Deeply decayed surfaces have gypsum plates in the joint and bedding planes, and at places selenite crystals are scattered over the surface. The purer massive chalk is of fine grain, porous texture, low specific gravity, and gives a characteristic dead or hollow sound when struck with a hammer. Its economic value lies in its use for the manufacture of cement and for building stone.

The chalk bluffs of the Missouri present a strikingly barren appearance and are usually of a conspicuous yellow color. The bluffs have a uniform height above the river for a distance of over 200 miles in Nebraska and South Dakota, but are notched by many small draws. The upper surface of the formation falls to within 8 or 10 feet of the river at Wheeler and Nieveen, S. Dak. For most of the distance, from a point 5 miles below Greenwood to Yankton, the Niobrara bluffs are prominent on one side of the river or the other. At a number of places slight faults and flexures were observed; most of the latter occur at the mouths of small ravines and appear to be caused by the swelling of beds. The steeper slopes are often covered with splinters of chalk rock broken from the cliffs above.

Section of Niobrara limestone and associated formations northeast of St. James, Nebr.

	Feet.
Loess. Rises in hills to an altitude of over 1,400 feet	40-50
Niobrara chalk, massive, somewhat sandy, and harder in lower beds. Base at 1,205 feet above sea level. Rises in hills to an altitude of 1,335 feet, or a thickness of 130 feet exposed	40-50
Carlile clay, dark and bluish, with some sand and sandstone. Large calcareous concretions 50 to 55 feet below top. Exposed in slope to river	71



CHARACTERISTIC FOSSILS OF NIOBRARA FORMATION AND GREENHORN LIMESTONE.

A, Ostrea congesta; *B*, Inoceramus labiatus.

Section of Niobrara limestone and Pierre shale on Bazile Creek at bend in road 1 mile south of Bazile Point, Nebr.

	Feet.
Pierre shale:	
Carbonaceous clay, dark in bank, lighter on weathered surface, which is strewn with selenite crystals and small yellowish concretions of irregular form	6
Niobrara:	
Weathered chalk, yellowish, with 3 or 4 light-colored streaks 2 inches thick and about 1 foot apart, *O. congesta* present	7
Chalk, beds irregular, sandy, and at places concretionary; gypsum plates occur in bedding and irregular joint planes. Lower beds 6 to 8 inches thick. *O. congesta* is the common fossil	8½
Blue chalk, lower 4 feet in 2 beds; large *Inocerami* and *O. congesta* present	8

Analysis of Niobrara chalk rock.

[Howison Crouch, analyst.]

	Unweathered specimen.	Weathered specimen.
Moisture	0.70	1.11
SiO_2	4.52	6.02
Organic matter	3.14	1.03
SO_3	2.14	.85
CO_2	37.80	37.11
CaO	49.66	47.98
Fe_2O_3 and Al_2O_3	1.87	5.92
Mg	Trace.	Trace.
	99.86	100.02

PIERRE SHALE.

The Pierre shale is the thickest member of the Cretaceous in Nebraska, varying in thickness from a few feet in northwestern Cedar County to over 500 feet in western Boyd County. The base, lying on the Niobrara, slopes down slowly from western Cedar County to central Knox County, beyond which it is either horizontal or has a slight rise westward. The eroded top reaches an altitude of over 1,900 feet in western Boyd County. At the cement works, 4 miles west of Yankton, S. Dak., the Pierre clay just above the Niobrara chalk is distinctly crumpled, a feature which may have been caused by the ice sheet.

During Eocene and early Miocene times this region was a land area eroded into hills and valleys. The Pierre clay was entirely removed in the eastern part, and on the rough upper surface later Tertiary and Quaternary deposits were laid down, to be themselves in turn partly removed by weathering and erosion.

The Pierre shale is commonly called "gumbo" and "soapstone," and consists principally of dark and bluish, plastic, and finely stratified clays. It carries lenses of limestone, and beds of shale, impure chalk, and thin layers of concretionary ironstone. At its base there is a dark carbonaceous clay, resembling coal, which is exposed along the Missouri, beginning in irregular lenses near Chamberlain, S. Dak. and extending as a continuous, well-marked horizon from a few miles farther down the river to eastern Knox County. At the latter place it contains, near the middle, an admixture of whitish clay, resembling fuller's earth and varying in thickness from 10 to 30 feet or more. The next horizon above is made up of dark and bluish plastic clays with thin seams of iron ore. Above this are alternating beds of shaly chalk and clay, the former weathering reddish; these chalky beds are often mistaken for Niobrara chalk. The highest beds of the Pierre, as observed in Boyd County, are bluish clay with some concretions of iron ore. The sections on page 17 give the strata more in detail.

The Pierre shale in this region is not rich in fossils. A few *Inocerami*, shark's teeth, and mososaur remains were observed by the writer. Mr. R. F. Stout, Center, Nebr., has collected from Pierre chalky beds about 72 vertebræ, the paddle bones, and pieces of ribs of a very large mososaur. He also secured crocodile bones and a number of *Belemnitella.*

The beds do not rise steeply in bluffs but, weathering rapidly, form rolling hills and long slopes. A typical hilly country of Pierre shale lies between Santee and Herrick in what is called the Devil's Nest. The hills, though usually either grass-covered or farmed where not too rough, show light to dark bands at different levels. This appearance is due to the alternation of beds, the chalky deposits causing light bands, the chalk stained with iron giving rise to yellowish soil, and the dark clays and iron-bearing beds giving brownish and dark streaks.

In the high ridge just north of Niobrara River and southeast of Spencer, certain hard beds at different levels cause flat summits or a series of irregular steps rising from east to west. The topography of the different zones of the Pierre is well shown along Bazile Creek, which has a grade of about 400 feet in 24 miles. Gradual clay slopes extend from altitude 1,560 to about 1,500 feet; steeper, chalky slopes with a narrower valley extend from altitude 1,500 to 1,400 feet; while the clays below give more gentle slopes and a wider valley down to about 1,280 feet, at which altitude the Niobrara chalk begins and bluffs prevail.

A very noticeable feature, especially in northern Holt County, is the presence along Niobrara River and its tributary creeks of many landslides, caused by the infiltration of ground water through joints in the clays, rendering them plastic. Fully 50 slides may be seen along Eagle Creek, between Turner and Ray, where Pierre clay rises from 60 to 100 feet in the slopes. At John Dolin's place, in sec. 26, T. 32, R. 11, a slide formed in 1893 has a length of 20 rods and vertical displacement of from 50 to 100 feet. It completely dammed Eagle Creek, causing the channel to shift several rods southward.

Section of Pierre shale along Bazile Creek ¼ mile southeast of Mackeyville, Nebr.

	Feet.
Bluish clay with flakes of iron oxide on surface	79
Dark, carbonaceous clay which, at places, is chalky, extending below the water in the creek	12

Section of Pierre shale and Niobrara limestone south of the Missouri River and 3 miles west of Fort Randall, S. Dak.

	Feet.
Pierre shale:	
Clay with ironstone over surface; some selenite above	13
Clay, yellowish, chalky, varies in character from massive, impure chalk to large concretions of chalk and clay. Dark, flat concretions occur at base	11
Clay, very dark; carbonaceous with thin, light-colored seams at base; definitely jointed, standing as buttresses, between which it weathers into amphitheater-like recesses; surface lighter where weathered; gypsum flour and selenite in joint and bedding plains. Lemon-yellow concretions occur near top of beds	28
Niobrara:	
Chalk, weathered above, darker below; with few fossils	40

Section of Pierre shale and overlying deposits, one-half mile northeast of Center, Nebr.

	Feet.
Loess	4
Sandy slope	9
Pebbles and gravel, then fine sand and glacial pebbles at base	30
Pierre shale:	
Dark clay, somewhat chalky when dry	1½
Light buff-colored clay, bedding not plain, showing gypsum flour and small selenite crystals in joint and bedding plains	4½
Clay, light, blue, or dark at places; chalky and hard. Rosettes of selenite common over upper 2 feet. Gypsum flour in cracks; crystals in joint and bedding plains	19
Clay, dark gray	2
Clay, dark, plastic, with 3 to 6 inch zone of oxidized iron concretions 32 feet below top. This clay seems to extend below the creek. Exposed	45

Section of Pierre shale above the Whiting Bridge, 7 miles southeast of Spencer, Nebr.

	Feet.
Clay, dark, plastic, with thin seams of iron	170
Yellowish clay, darker where not weathered, with some portions bluish	40
Chalky beds, at places hard enough for building purposes	2
Alternating dark shale and clay; the shaly beds stand out as buttresses	36

Altitude of river, 1,502 feet; top of slope, 1,750 feet.

TERTIARY SYSTEM.

Two formations of later Tertiary age occur in this region: one is the Arikaree, which has a wide range over western Nebraska and adjacent States; the other, which has no name, consists of certain stratified sands and clays found in Holt, Knox, and Cedar counties.

ARIKAREE FORMATION.

The Arikaree formation is composed of grayish sand and sandy clays, with local beds of sandstone, quartzite, conglomerate, and fresh-water limestone, which, in the table-lands of Boyd, Holt, and Knox counties, are 100 feet or more thick. From these nearly level areas the formation thins on the slopes and ridges toward and between the streams. Certain outliers in the eroded areas give rise to buttes of more or less prominence. Originally the formation extended over all of the western part of the region to which this report relates and well into Cedar County and perhaps farther east, but by subsequent erosion it has been widely removed, leaving only a few remnants, capping buttes on some of the northwest-southeast trending ridges to the east.

The sandy portion of the formation is in part unconsolidated, the grains usually being feebly cemented by a small amount of calcium carbonate. Where there is more complete cementation there are local beds of sandstone which generally show cross-bedding. In several cases the rock contains pebbles. In most of the buttes there occurs a hard, greenish sandstone or quartzite with a silicious cement, identical with that found in the Bijou Hills of South Dakota and at Woodruff, Kans. These hard beds do not occur at definite levels, the nature and kind of the rock often changing within a few feet.

Not many fossils are found in the Arikaree formation. Silicified wood is abundant on the place of Andrew Lukup, southwest of Verdigre. Several mammalian bones have been found about the buttes, but the writer saw only one bone of that class embedded in the rock. The most conspicuous outcrops are in the well-known Twin Buttes, 10 miles west of Butte, Boyd County (Pl. VII, *A*), and Stony Butte, 2 miles southwest of Verdel, Knox County. Twin Buttes, 2,060 feet in altitude, are so prominent that they can be seen for many miles, even from points in South Dakota beyond Missouri River. From the top of the southeast butte, which rises over 100 feet above the plain, a good idea can be gained of the former extension of the Arikaree table-land north in Dakota, west in Keyapaha County, and south in Holt County. The altitude of Stony Butte is about 1,700 feet; in it the Pierre clay is capped by 25 feet of Arikaree formation, the latter being composed of cross-bedded sandstone and quartzite, with a small amount of sand at the base. As

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A. ONE OF THE TWIN BUTTES, BOYD COUNTY, NEBR.

B. KNOLLKEMPER DAM, TURNER, HOLT COUNTY, NEBR.

this sand crumbles out or washes away, the hard beds above are undermined and break into large pieces or bowlders which scatter over the Pierre slope below.

Section of Tertiary deposits in bluffs northeast of Badger Bridge, Boyd County, Nebr.

	Feet.
Sand and gravel in slope	38
Sandstone, quartzitic, greenish to light, cross-bedded, weathers to light color	2
Sandy loam, grayish, light on surface, darker in bank; not plainly stratified; contains in upper part hard concretions 6 to 8 inches in diameter. These break into irregular pieces showing dendritic structure	7
Loam, grayish, sandy, weathers to a yellowish or buff color, resembling loess; lies on Pierre shale at an altitude of 1,800 feet	62

Section of Tertiary deposits at the southeast Twin Butte, Boyd County, Nebr.

	Feet.
Sandstone; 3 feet top of grayish to greenish and quartzitic, the rest friable, cross-bedded, and showing plant-like tubes	10–15
Gray sand	5–10
Porous rock consisting of sand and pebbles in a limy matrix	6–10
Clayey sand, greenish in beds, grayish on surface	90?

In a field just north, and at the top of the bluffs along Keyapaha River, this lower sand is underlain by a bed of greenish quartzite, beneath which is a bed of loam lying on Pierre clay.

PLIOCENE DEPOSITS.

At the close of Arikaree time the region was extensively eroded by drainage, which for a while at least flowed from northwest to southeast. A few remnants of the deposits of these old, high-level streams may be seen extending southeast across Gregory County, S. Dak., and at other points farther west. The longer axes of the buttes of Arikaree formation in Boyd County extend in the same direction. Parts of northeastern Nebraska were considerably eroded at this time, but finally received the sand and gravel deposits which are thickest to the east and south. The old channels extending across Knox and Cedar counties and described by Prof. J. E. Todd[a] may have been outlined at that time, for they appear to be related to the old channels farther northwest. Old valleys connect Ponca Creek and Niobrara River in secs. 25, 26, and 36, T. 34 R. 14, and south of the buttes near Butte. Sandy gravel-capped ridges trending northwest-southeast, with intervening dry valleys, occur at various places, notably southwest of Butte.

The so-called Pliocene deposits consist principally of stratified sand with some gravel and clay, which comes to the surface in southeastern

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[a] Todd, J. E., Moraines of southeastern South Dakota: Bull. U. S. Geol. Survey No. 158, 1899, pp. 6061.

Holt and southwestern Knox counties and lies beneath loess and glacial drift in much of Knox and Cedar counties. The best typical exposures occur in the Devils Nest region between Santee and Herrick, where a thickness of 50 to 100 feet has been observed. The relations of these beds to the Arikaree drift and loess has not been fully ascertained; while they are usually described under the name Pliocene it seems highly probable that the accumulation of much of the formation so characterized extended well into Quaternary time.

QUATERNARY SYSTEM.

Deposits belonging to this system consist of glacial drift, loess, alluvium, and dune sand.

GLACIAL DRIFT.

The drift is composed of irregular masses of bowlder clay and of sand and gravel beds with an admixture of bowlders at places, these materials having been carried to the region by the glacial ice sheet and streams. The bowlder clay is exposed lying on the Cretaceous and Tertiary deposits at various points along the deeper valleys, and is reached in wells at a number of places; it frequently contains northern pebbles and bowlders. Gravel and sand beds are of wide extent under the loess; they rise to an altitude of over 1,600 feet in northwestern Knox County, where they mix with somewhat similar materials of western origin. Along some of the principal streams the gravel beds appear as a terracelike cap. Bowlders occurring in connection with the gravel are found along the streams and on hill slopes in Knox and Cedar counties, where, as a result of undermining, they fall or roll to lower levels; one of the most conspicuous deposits extends from 1 to 3 miles north of Hartington. In Dixon and Dakota counties they seem to be buried beneath the loess and to be in small numbers, as well drillers rarely find them. The western limit of northern drift extends from near Verdel southward along Verdigris Creek.

LOESS.

This important surface formation, often called the Bluff deposit, extends over most of Nebraska east and south of the sand hills, and into Iowa, Missouri, Kansas, and other States. It is composed of fine sand and clay particles and contains a small amount of calcium carbonate which holds the grains together loosely. The nearly universal buff color is due to the presence of a small amount of yellow oxide of iron. The thickness varies from a few feet to over 100 feet. Its most noticeable feature is the uniformity of porous texture and massive structure throughout, with only occasional traces of stratification. In western Knox County the loess becomes sandy or changes to a loesslike silt. A close examination of a loess bluff shows faint vertical cleavage and usually the presence of small, light-colored, irregular concretions. Very small shells, usually of land forms, occur at many localities.

The origin of the loess is still a disputed question, some geologists holding that it is a wind deposit, while others claim that it has been deposited in water. From its character and relations in this region, it seems probable that the principal agency has been wind, but the deposits were locally modified by water.

The eastern part of the area described in this report has a hilly loess topography. Near Ponca many vertical slips due to the vertical jointing were observed in the hills, where they are locally called "cat steps." The vertical displacement causes the formation to slide over and cover banks in which older formations occur. Where the talus is removed from below by a stream or other agent, nearly vertical loess bluffs result.

Near Cook Creek, close to the east side of the Santee Indian Reservation, a loess escarpment begins as a bluff rising from 100 to 200 feet above the Cretaceous clays in the Devils Nest below. This high ridge extends southeastward and then curves northeastward to a high hill 4 or 5 miles southwest of St. Helena. The noticeable feature is that the slope is southward from the brink of this escarpment. The loess similarly slopes away from the brink of the Missouri Valley just south of Vermilion Landing, Cedar County.

ALLUVIUM.

Alluvial deposits composed of sand, clay, and some gravel, floor the principal valleys. These deposits have also been called valley wash and bottom land, while their upper surface is referred to as a flood plain. Level areas of the same nature but somewhat higher, are called benches or alluvial terraces. The alluvial flats along Missouri River vary in width from about 2 to over 10 miles, being widest along Dixon and Dakota counties; between Jackson and Homer they form the extensive bottom lands.

Alluvial materials comprise flood-plain and alluvial-fan deposits. The former have been deposited principally by the Missouri, while the latter, which are well shown between Ionia and Ponca, have been carried from adjacent slopes by weak tributaries, and scattered over the flood plain at the mouths of ravines. The thickness of the alluvium averages much greater than the depth of the river channel; a thickness of 185 feet is reported in the Joseph Holtzbauer well near Aten.

The bottom lands along the Niobrara average from one-half to three-fourths mile wide and are very sandy. Nearly all of the smaller streams flow on narrow beds of alluvium.

DUNE SAND.

In certain areas the wind has blown Arikaree, Pliocene, and alluvial sands into small dunes or sand hills. The principal area lies south of Niobrara River, and is from 5 to 8 miles wide, extending from the western part of Holt County to near Bazile Creek. A few small "blow-outs" occur on the highland west of the town of Verdigre. Low sandy ridges, extending in a northwest-southeast direction, occur at several points in Knox and Cedar counties; they were formed earlier than the dunes on the alluvial flats. At a number of places the loess is completely covered by drifting sands. A few small dunes are found on the Logan Creek bottom, near Laurel.

ECONOMIC GEOLOGY.

MINERAL RESOURCES.

BRICK CLAY.

Cretaceous clays and the loess are used successfully in the manufacture of brick. Twelve brickyards were operating in the region in 1903.

SAND AND GRAVEL.

Building sand in unlimited amounts is found along Niobrara and Missouri rivers, and is plentiful in the Tertiary and Quaternary formations. The principal loading station is at Stewart, Holt County, where the sand is scooped onto cars and sent out by trainloads. Gravel suitable for ballast occurs in terraces and in the glacial deposits at many places. Glacial bowlders have been used as foundation materials.

BUILDING STONE.

No very attractive and durable stone is found in northeastern Nebraska, and that available occurs under unfavorable conditions. The stone most used is the greenish Arikaree quartzite described on page 18. It is hard and fairly durable, but works in poor form, as the deposits are of very irregular character. It is quarried in most of the stony buttes and at a few lower levels, and is used principally for foundations and milldams. Most of this material is obtained (1) from many places in northern Holt County, as at Ray and Turner, where it is found in residual bowlders; (2) at John Vicknish's quarry, near Ray; (3) northeast of Badger Bridge; (4) in the vicinity of Twin Buttes; (5) just south of the town of Butte; (6) 3 miles north and one-half mile west of Spencer; (7) at the Stumbo quarry, in sec. 20, T. 33, R. 10 W., between Lynch and Gross; (8) on the divide south of Monowi; (9) on Stony Butte, 2 miles south of Verdel; (10) 6 miles southwest of Verdigre; (11) on the divide between Verdigre

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and Center, and (12) 2 miles southwest of Aten. The quartzite is excellent for concrete work and it would make very fair ballast if crushed.

The Greenhorn limestone is used somewhat for foundations, and the Niobrara chalk, though soft, serves fairly well as a building material where it can be placed above ground water. In some houses it has stood over twenty years with little sign of decay. The Menominee Church, in northern Cedar County, and the house of C. D. Buhro, sec. 20, T. 32. R. 2 W., Knox County, are good examples of this.

The lens of limestone in the Pierre formation 7 miles northwest of Verdigre has been used to some extent as a source of building stone, but there is only a limited supply of it and considerable stripping is necessary.

At Jackson, Homer, and a point 5 miles southeast of Homer, a fair grade of sandstone is found in the Dakota, but the conditions for quarrying are not favorable.

CEMENT ROCK.

A large portion of the chalk rock of the Niobrara formation is suitable for cement manufacture and, with the growing demand for Portland cement, the production of this material may prove profitable in northeastern Nebraska. It is now manufactured extensively across the river in South Dakota, in mills located 4 miles west of Yankton and 1½ miles north of the river. The plant has been running thirteen years, supplying cement to South Dakota, Iowa, Nebraska, and other States; the output is 300 barrels a day, with 60 men working. The materials used average about 4 parts of Niobrara chalk to 1 part of Pierre clay. The top of the chalk here is weathered and has to be stripped to a depth of about 15 feet. The chalk and clay are mined or quarried, crushed together, thoroughly mixed, and then carried by water slushes to drying vats, where the mixture is dried by solar heat, and separated into blocks. Then come kiln burning, final grinding, and preparation for shipment. A view of the works is shown in Pl. VIII, *A*.

The formations worked at Yankton are exposed in Nebraska along Missouri River from Dixon County to northern Boyd County and afford a vast supply of the raw materials. The principal factors to be considered in the establishment of a plant, besides the presence of suitable cement materials, are the condition in which they are found so as to avoid waste in quarry strippings, the water supply, fuel, and a suitable location, especially in relation to transportation facilities. All of these conditions except cheap fuel exist at many places on the Nebraska side of the river. At Niobrara the chalk rock is of good quality and in large supply, and this place is favorably situated for railroads and river transportation; artesian water and a suitable location for a plant can also be had. A view of an outcrop at this place is shown in Pl. VIII, *B*.

COAL.[a]

For nearly fifty years there has been more or less prospecting for coal in northeastern Nebraska, but the results have been most unsatisfactory. Near Ponca Landing, from 10 to 18 inches of an inferior grade of lignite is found in the basal portion of the Graneros shale, and it has been worked in a limited way. Near Jackson two holes were recently sunk, which found two thin beds of lignite in the Dakota. In a high bank southeast of Homer a thin bed of lignite rises 85 feet above the river. Paying quantities of coal are not to be expected in this region. The following analyses of Dakota County lignite, by Mr. E. F. Burchard, may be of interest in this connection:

Analysis of air-dried lignite from near Jackson, Nebr., at a depth of 65 feet.

[E. F. Burchard, analyst.]

Water	4.03
Volatile matter	51.40
Fixed carbon	33.66
Ash	10.91
	100.00

Sulphur undetermined.

Analysis of air-dried lignite from shaft near Jackson, Nebr., depth 82 feet.

[E. F. Burchard, analyst.]

Water	6.47
Volatile matter	27.24
Fixed carbon	49.27
Ash	16.23
Sulphur	.86
	100.07

PEAT.

While there has been no development of peat as a source of fuel in any part of the area, it seems probable that it may be found in considerable quantities in some of the boggy basins. One of the localities that should be investigated is the basin of Perrin Creek, in Cedar County.

VOLCANIC ASH.

Volcanic ash beds which may yet prove of some importance occur in Holt, Knox, and Dixon counties.

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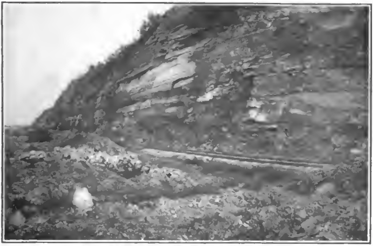
[a] Extended accounts of the lignites of Dakota County are given by E. F. Burchard in Contributions to economic geology for 1903: Bull. U. S. Geol. Survey No. 225, 1904, pp. 276–288; and in Geology of Dakota County, Nebr.: Proc. Acad. Sci. and Letters of Sioux City, 1903–4, vol. 1, p. 150.

A. CEMENT PLANT NEAR YANKTON, S. DAK.



B. NIOBRARA FORMATION JUST WEST OF NIOBRARA, NEBR.

WATER RESOURCES.

GENERAL STATEMENT.

Of the water which falls upon the land, part runs off into surface streams, part evaporates, and part is absorbed by the land and by plant growth. The proportions vary with the rainfall, soil texture, geologic structure, and topography, the volume of rainfall being the most important factor. In northeastern Nebraska the rainfall varies considerably in the different counties, with a general diminution from east to west, the normal annual precipitation ranging from 27 to 28 inches in Dakota, Dixon, and Cedar counties to less than 23 inches in parts of Boyd and northern Holt counties. Mr. George A. Loveland, meteorologist at the University of Nebraska, gives the following data:

> Normal annual precipitation at Agee, Holt County, 23.87 inches; Lynch, Boyd County, 23.33 inches; Santee, Knox County, 22.78 inches; Hartington, Cedar County, 27.53 inches; Elk Point, South Dakota, 27.61 inches. The maximum amount of rainfall is in May and June, or during the growing season. Nothing definite is known concerning the amount of evaporation from different soil surfaces in this section. The maximum evaporation is during June, July, and August.

The absorbent power of the soil is greatest in the loess and sandy areas which occupy much of the area. On certain clayey soils on steep slopes the run-off is large, notably on some of the Pierre lands. Water absorbed and collected in the soil is called ground water; it moves slowly downward until it reaches some impervious layer, above which it accumulates in varying amounts, in many areas completely filling or saturating thick beds of sand. The ground water moves slowly from higher to lower regions, at a rate which is greatest in coarse or porous beds. Heavy rains raise the upper surface of the ground water, while long dry spells, when evaporation is greatest, lower it.

A few lakes in the sand hills north of Turner show well this rise and fall of the water table, filling up during wet weather and disappearing at dry times. During the dry years 1893 to 1895 the water table lowered very perceptibly, while during 1903 it rose and numerous new springs appeared at the surface. The ground water also is the source of the shallow wells' supply.

SURFACE WATERS.

STREAMS.

The Missouri River carries a large volume of water, and although its grade is less than 1 foot to the mile it flows rapidly. It is important as a source of water for drinking, domestic purposes, and stock. Many persons drink the turbid water as it comes from the river, but in most cases it is settled in vats before using. While it affords a good supply of stock water, many cattle and a few horses are lost each year by falling into the river at caving banks. These unfortunate animals rarely escape, for, although they gain a footing at some sloping bank, they usually can not climb out, and finally die from exhaustion. The Missouri is also an important avenue for transportation by means of steamers of small size, which carry grain, stock, lumber, and passengers.

Niobrara River receives most of its water from springs at the base of the Arikaree formation. The following discharge measurements were made near the village of Niobrara:

Discharge, in second-feet, of Niobrara River near Niobrara, Nebr.

Date.	Hydrographer.	Discharge
April 6, 1901	**O. V. P. Stout**	1,59
April 7, 1901	do	2,115
May 11, 1902	**J. C. Stevens**	1,62
July 6, 1902	do	2,02
July 25, 1902	do	1,4
August 21, 1902	do	1,10

The stream is shallow and relatively swift, flowing among many sand bars. The water is not deep enough for boating. In this section the south slopes are usually sandy, while those on the north are clayey and very steep. Except for stock and locally for domestic purposes the water is not extensively utilized.

Ponca Creek is a weak stream in a large basin. It heads in south-central South Dakota, in many broad, shallow valleys which carry but little water.

Many water powers available in this region could be utilized to advantage. While power sites are found in each county, the most favorable conditions prevail in Knox and in the northern part of Holt County, where the powers are mostly on the smaller or spring-fed streams, which are not much affected either by floods or dry weather; these have steep grades and keep open most of the winter. As the country becomes more populous there will be increasing demand for water power, which is little used now except to run a few flouring and grist mills.

SPRINGS.

Springs are an important water resource in all the counties, affording most of the local water supply. The principal horizons from which they flow are (1) between the Tertiary sands and the Pierre clay, (2) between Glacial drift and the Pierre, and (3) from the Dakota sandstone.

The porous Arikaree formation contains a large supply of ground water which sinks to the impervious Pierre clay, along the top of which it flows until it reaches the surface on the hill slopes. This condition is shown by the existence of frequent springs at the base of the Arikaree sands, whence the water flows out over the clay slopes below. This horizon lies high on the slopes in the western parts of Holt and Boyd counties and somewhat lower in Knox. In all cases the same general conditions prevail—an impervious bed checking the downward motion of water accumulating in a porous formation, and a lateral flow to the surface. The water from a series of springs often collects into a flowing stream, but, on the other hand, soil often chokes or checks the flow, especially in pasture lands where cattle and horses assist the process by tramping. During exceptionally humid years, ground water reaches the surface at additional places, producing transient springs. These are often called wet-weather springs, and are evidence of extensive seepage not far back in the slope which, by suitable trenching, can often be opened so as to furnish a permanent flow. Sometimes a short horizontal well or tunnel will reach a permanent supply. Where the formation is not too sandy the same result can be accomplished by boring and drilling.

Boggy places, where the ground water seeps to the surface, occur along certain streams in each county. The springs coming from the Dakota sandstone are, in part at least, seepage from the artesian waters, a portion of which reaches the surface in the eastern part of the area to which this report relates.

UNDERGROUND WATERS.

SHALLOW WELLS.

Shallow wells, like most springs, draw their supply from the ground water. The amount of water which a well will afford within a given time depends on a number of conditions, the principal one of which is the nature of the pervious bed. Thoroughly saturated gravels and coarse sands deliver water faster than fine sand. As water is pumped from the well the surface of the water lowers, but this is slow and hardly perceptible in cases where the materials are coarse and there is an abundance of water. It is desirable, therefore, to find water-bearing beds of coarse sand or gravel, and material of this sort prevails at most localities in this region. The water from the Cretaceous formations is generally bad, except that from the Dakota sandstone, and even this is often charged with mineral matter. The Tertiary and Quaternary deposits generally yield a suitable supply of water of good quality. Wells, except the deeper tubulars, vary in depth from a few feet to between 200 and 300 feet, and in diameter from 2 inches to several feet. They are cased with wood, brick, tile, cement, stone, and iron pipe, the first named being mostly used, and the last named being used in driven wells. Wells are dug, drilled, bored, and driven. The water level in most shallow wells is affected

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somewhat by weather changes. Those on the Missouri bottom, when near the river, seem to fluctuate somewhat with the flood and low-water stages of the river.

ARTESIAN WELLS.

Artesian conditions.—The entire area treated in this report is underlain by the water-bearing Dakota sandstone, which yields artesian wells in many districts. Part of this water comes to the surface in numerous springs in Dixon and Dakota counties, but to the west it lies at depths gradually increasing to 1,500 feet or more. The source of this water is in the Black Hills and the Rocky Mountains, where the Dakota and associated sandstones are extensively exposed. Thence this sandstone dips eastward beneath later Cretaceous clays, but it comes to the surface along Big Sioux River, in Iowa, and also along Missouri River below Ponca, Nebr. The sandstone is porous, and also thick enough to receive and carry large amounts of water. The supply is gathered in the mountain areas and flows very slowly through the sandstone to the lower regions east, where (as, for instance, along the valleys and lower lands of Nebraska and South Dakota) part of it comes to the surface through springs and artesian wells. An important factor is the thick mass of impervious clay and shale overlying the water horizon and preventing its escape in the wide area of plains between the mountains and the Missouri. Such beds overlie the Dakota sandstone as far east as Ionia, Nebr., in the river valley and somewhat farther on the highlands. Talus slopes, glacial clays, and fine sands aid greatly in checking the free escape of water in the eastern outcropping area. Owing to the high altitude of the gathering grounds on the mountain slopes, 4,000 to 5,000 feet, and the low altitude of the region east, the water is under such pressure or head that it flows slowly eastward through the porous sandstone.

The Carboniferous beds which underlie northeastern Nebraska carry artesian water, but at a considerable depth. This horizon was reached in wells at Sioux City, Iowa, and at Ponca, Nebr.

The sandstone of the Carlile formation carries artesian water and yields the weak "pencil" flow or "straw" flow of Knox and Cedar counties. Some of the artesian springs farther up the river may issue from this horizon.

Chemical composition of artesian water.—The chemical composition of artesian water seems to vary somewhat with the different flows and localities. The most common mineral compounds present are sulphates of soda, lime, and magnesia, chloride of sodium, and iron, all usually in small amount. There is only a trace of organic impurity.

The following analysis of water from the small school well, Santee, Nebr., was made by Prof. Robert O. Riggs:

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Analysis of water of small school well, Santee, Nebr.

	Parts per million.
Silica (SiO_2)	9
Aluminum (Al)	2. 1
Calcium (Ca)	242
Magnesium (Mg)	48
Sodium (Na)	87
Potassium (K)	29
Sulphate radicle (SO_4)	733
Carbonate radicle (CO_3)	84
Bicarbonate radicle (HCO_3)	68
Chlorine (Cl)	55
	1, 357
Total solids	1, 360

The iron was not determined but there is more of it in the water of this well than in that of the large school well.

Pressure.—Owing to the elevated source of waters in the Dakota sandstone, these would be under great pressure under the lowlands east were it not for the leakage in the outcrop area which causes the " head " to gradually decrease from west to east. The pressure or head is of great practical importance, for it determines the height to which the water will rise, and consequently the area within which artesian flows are to be expected. This area, deduced from observed pressures, is shown in Pl. IX (in pocket). As the Dakota is composed of alternating beds of sandstone and clay which often are distinct, there are different flows, called " first," " second," " third," etc., which have different pressures or heads, usually greatest in the lowest. This is because there is freer leakage from the upper than from the lower sandstone horizon.

In northeastern Dixon County there is no pressure in the upper sandstone beds of the Dakota formation and only enough in the lower beds to raise water a few feet above the level of Missouri River. Farther west, in northwestern Dixon County and northern Cedar County, the pressure is so small in the upper beds that the flow is not strong, but at lower levels a greater pressure is found.

At Niobrara the pressure is strong enough to force water about 210 feet above the mouth of the Mill well, or to an altitude of 1,450 feet. As above explained, the pressure and head increase from east to west, and if it were not for the fact that the rise of the country is usually more rapid in that direction than the general increase gradient of the water head, artesian water could be obtained over a much greater area. As it is flowing wells are obtainable only in the valleys. At Lynch, at an altitude of about 1,392 feet, there is a closed pressure of 85 pounds to the square inch. Allowing a head per pound of 2⅓ feet (the height of a 1-inch column of water weighing one pound), the water would rise in a pipe 198 feet above the mouth of the well, or to an altitude of over 1,590 feet. As the well is 923 feet deep there is sufficient pressure to raise water in all 1,121 feet. Dividing 1,121 by 2⅓ we find that the pressure at the bottom of the well is 480½ pounds per square inch.

In the Rosebud Agency well farther northwest, in South Dakota, the artesian water raises to an altitude of 2,000 feet. Different wells in a given locality may show different pressures. The variations may be due to one or more of the following conditions: (1) Difference in the horizon of the flow, the pressure being greater with deeper flows; (2) escape of water outside of the casing; (3) leaks in the casing due to rust; (4) difference in altitude of mouths of wells; (5) choking of flows by sand or clay; (6) proximity of wells causing local interference and decrease below the average pressure; (7) short, loose, or broken casing permitting leakage from a lower sandstone into an upper one.

Temperature of artesian water.—In a given locality the temperature is highest in the deeper wells. There is a gradual decrease eastward from over 80° F. in the deep well at Lynch to 54° in one of the Ryan wells in the northern part of Dixon County. It has been observed that the shallow artesian wells with weak pressure have about the same temperature as springs.

Construction and care of wells.—It was noted that in many cases but little care had been taken in the selection of proper sites and in the construction of wells in northeastern Nebraska. Some wells have been drilled on land too high for a flow, even when a lower position would have been just as convenient to the owner. Some wells on moderately high lands, which did obtain feeble flows, have since ceased flowing. Wells should be carefully cased, and the casing should fit tightly into cap rock and permit no leakage. Below the cap rock perforated pipe should be used for a part of the distance at least to prevent sand choking the end of the casing. In too many instances there is not enough casing, and it is often so loose that water flows outside of it to the surface. It is best to use double casing. Water standing about the mouth of the well causes the pipe to rust badly, but this can easily be prevented by carefully piping and grading. One of the largest and most expensive wells in the area was lost by the rusting of pipes near the surface; in this case there was a pond of water about the well. In wells with double casing the old inner pipe can be drawn and replaced by a new one.

Large and expensive wells to be used for power should be put down by experienced well drillers who understand how to cut off the upper and weaker flows and produce a well with the greatest possible pressure. It has been found best to keep such wells closed when not in use. If properly cased and not running sand there is

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no danger of injuring the well by shutting off the flow, but it should be shut off gradually.

Diminution in pressure and supply.—It is believed that in some portions of the artesian area the pressure and volume of flow is diminishing, but reliable data bearing on this point are difficult to obtain. Many wells decrease in volume after flowing some time, but the change is often due to breaks in the pipe, leakage, and clogging by sand or iron rust. Sometimes the diminution is local and due to the large number of wells. It is claimed that the pressure in the first and second flows in the Dakota sandstone is decreasing in Cedar County; the first flow at present runs a 2-inch pipe half full, while formerly it ran a full pipe; the second flow, about 80 feet deeper than the first and having more pressure, shows but little change; the third flow, from 30 to 40 feet below the second, has changed very little, if any.

BLOWING WELLS.

Blowing wells are found at a number of places in Nebraska, especially in Jefferson County. They are also known as "breathing," "howling," and "weather" wells. They occur at several localities in southeastern Knox County and about Mineola, Holt County. The wells have a depth of from 125 to about 200 feet, passing through loess, sand, dry gravel, and sand into water gravel. In some cases there is only a slight movement of air into and out of the well, called "sucking" or inhalation and "blowing" or exhalation. Where the casing is tight above and the opening small a very audible noise may be produced. The movement of air, up or down, seems to depend on the barometric pressure. When the air is heavy during a high barometer the movement is inward, while when the air is light during a low barometer it is outward. Since the well and weather phenomena correlate so closely the wells are called weather wells, and the changes in atmospheric pressure are supposed to cause the "blowing." The dry gravel below forms a reservoir into and out of which air readily passes. While there is more or less air in all formations, that in the porous beds moves most freely. Naturally this reservoir of air is affected by pressure, and the well is an artificial connection between the atmosphere and the air in the porous beds below. Inhalation during very cold weather causes the pipes to freeze sometimes as far down as the water. As soon as a reverse movement begins the pipes thaw out rapidly.

Mr. Charles C. Cleveland, of Creighton, Nebr., furnishes the following description of his well:

> My well is 3 feet in diameter and 165 feet deep, dug through loess, 80 feet; sand and gravel, 65 feet; clay, 20 feet. From this clay a 2-inch hole was bored down to water gravel from which the water flowed 15 feet deep in the 3-foot hole. In this well there is at times a current of air moving in or out, although

during much of the time it is entirely still. When the weather moderates in winter or is getting warmer at any time the well blows, and the air hissing through the platform can be heard rods away. When the weather turns cold, the air is sucked in. This air must have come out of the dry gravel below the loess. The pump platform has to be made air-tight in winter to prevent pipes freezing to the bottom of the well. All deep wells in this vicinity are blowing wells.

POLLUTION OF WELL WATERS.

Water is rendered impure by the presence of mineral and organic matter. Some kinds of these may be present without affecting the desirableness of the water for drinking and domestic purposes, but most impurities either are, or are likely to become, injurious to the health. The water supply which comes principally from shallow wells and springs often become contaminated from the surface and is then a source of contagion. Many cases of typhoid fever have come from this cause. The site for a dug well should be selected with great care and should be as far as possible from barnyards, backhouses, etc. All surface drainage should be kept away. Placing a well on higher ground than the house and outbuildings is not always a safeguard, for the water level in a well is so low that in some cases there may be a direct underground seepage from a dangerous source of contamination. Wood curbing often fouls the water by rotting. Spring water may also become polluted if it flows from sands not well protected from surface contamination.

WATER RESOURCES BY COUNTIES.

NORTHERN PART OF HOLT COUNTY.

Topography.—The northern part of Holt County drains northeastward to Niobrara River. It is a thinly settled region of over 900 square miles, in which stock raising and dairying are the principal industrial pursuits, especially where the land is rough or sandy. There is considerable farming on the table-land just north of Stewart, Atkinson, and O'Neill. North of this table-land the slope to the Niobrara is quite perceptible, as there is a fall of 400 to 500 feet in from 15 to 25 miles. Tertiary sands form the broad surface slopes. A sand-hill area 5 to 8 miles wide, but with indefinite boundaries, lies just south of Niobrara River and extends across the northern part of the county. The surface sands and gravels here were derived in part from the Tertiary sands and in part from materials brought into the region by Niobrara River when it flowed at a higher level. Beneath the sandy formations the whole region is underlain by Pierre clay, which comes to the surface along the Niobrara and along the lower courses of the principal creeks, forming steep slopes.

The main stream is Niobrara River. Its principal tributaries in this county are the Redbird, Eagle, Big Sandy, and Beaver creeks.

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all of which head in the table-land and flow northeastward to the river. They are fed principally by springs and flow all the year, the run-off not being much affected by the average rain or by dry weather. The streams vary in length from about 15 to 30 miles, and the grade varies but is generally steep. The valleys are narrow and semicylindrical in form at the edge of the table-land, wider and more mature across the Tertiary slopes, and more deeply trenched in the outcrop zone of Pierre clay. The stream water is used principally for stock and to some extent for domestic purposes.

Water power.—None of the creeks have been gaged, but it is evident that they would afford much water power, and the conditions are such that power could be easily and cheaply developed. There are favorable places for inexpensive dams along all of the creeks, while on some of the principal creeks there are numerous power sites. At Turner, Mr. William Knollkemper has a dam (see Pl. VII, *B*, p. 18) 150 feet long and 8 to 10 feet high, constructed of brush, clay, and manure. The power is used to run a well-equipped flouring mill, with a capacity of 60 barrels a day, which has been in operation for twenty-five years. The dam cost but little, for it is simply a crude breakwater which diverts part of the stream into a mill race. For several years a mill was operated on the Big Sandy, near Badger, but it was recently moved to Butte, Boyd County. The dam and race have been somewhat improved and power will be transmitted to the mill at Butte, a distance of 7 miles.

The main drawback to the development of water power for mill purposes in the northern part of Holt County is in the lack of shipping facilities for mill products. However, cheap power could be developed and transmitted to railroad towns both north and south. This plan ought to prove feasible, as fuel for power is high priced.

Springs.—Springs from Tertiary and terrace sands and gravels lying on the impervious Pierre clay are numerous along all of the creeks. They afford a large supply of good drinking water, and are used for domestic purposes, stock water, and for irrigation when needed. About Ray they are found on many farms and occur numerously about Saratoga on a small tributary of Eagle Creek. Above Turner on sec. 26, T. 32, R. 11 W. the John Donlin Springs seep out of the sands. Little Sandy Creek heads at a large spring. Near Phoenix some heavy springs are used to irrigate a large orchard, and 5 miles west of Badger some strong springs are used for irrigation during dry years. The Mullehan Springs near Paddock are well known; the water comes out of sand and gravel above the Pierre clay, forming a small fall 35 feet high. In this vicinity there are several very strong springs, most of which are not used. Near the mouth of Eagle Creek springs supply large fish ponds and in dry seasons irrigate from 15 to 20 acres of orchard and garden. At another ranch 2 miles east the spring water, conducted by a ditch three-fourths mile long, is used for irrigation purposes. The springs of this county could be used to greater advantage than they are at present, for in most cases they are high on the slopes and might be piped to and through the houses, which are generally located in the valleys below. Also it seems probable that by boring or by tunneling the ground water at boggy places not far below the table-land could be tapped and caused to flow out as strong springs.

Shallow wells.—Since settlements usually begin along the streams or at springs, few wells were put down until the country back from the natural water supply began to be used, first for grazing and later for farming. In much of the higher area of the county sandy formations yield a suitable supply of water, usually soft. At a few places, as north of Middle Branch, the water is in fine sand and is difficult to strain. There are several blowing wells in the vicinity of Mineola.

The following table will serve to show the different well-water conditions:

Representative wells of northern Holt County, Nebr.

Owner.	Location.	Depth.	Diameter.	Depth of water.	Remarks.
		Feet.	*Inches.*	*Feet.*	
O'Neill	O'Neill	1,400	([a])	1,360	Some had water. Failure. Cost $3,000.
J. M. Packard	Sec. 12, T. 29 N., R. 9 W.	160	2	....	Sand all the way down, on high ground. Uses Cook strainer.
E. H. Lees	Sec. 28, T. 31, R. 10 W.	60	8	10	On high ground. Through 57 feet of sand into gravel.
H. R. Henry	Sec. 22, T. 30, R. 10 W.	68	10	9	Through sand and gravel to coarse gravel. Blowing well. High ground.
George Tomlison	Sec. 25, T. 31, R. 10 W.	76	8	12	High ground.
A. B. Powell	Sec. 3, T. 31, R. 10 W.	80	8	8 or 9	Do.
A. L. Wilcox	Sec. 18, T. 31, R. 12 W.	16	42	4 or 5	In valley.
Mr. McGowen	Sec. 24, T. 31, R. 12 W.	365	....	....	Through sand and gravel 15 feet into Pierre clay. On Red Bird divide.
Henry Lasher	Sec. 24, T. 31, R. 12 W.	120	8	14	Log: Clay and sand, 25 feet; clay, 20 feet; hard sandy layer, 1 foot; soft decomposed layer; sand.
J. J. Schwetzer	Sec. 36, T. 31, R. 12 W.	8	36	....	Dug well. In valley.
A. Dobson	Sec. 12, T. 33, R. 12 W.	20	....	12	In valley.
J. F. Green	Sec. 9, T. 33, R. 14 W.	18	12	8	Water in pure white sand just above Pierre clay.
Frank Sanders	Sec. 12, T. 33, R. 15 W.	20	10	10	Abundant supply.
William Dusten	Sec. 22, T. 33, R. 15 W.	90	12	....	
Winslow Bros	Sec. 14 T. 33, R. 14 W.	28	5	10	Easily lowered Through soil, sand, gravel.
A. W. Sexton	Sec. 33, T. 34, R. 14 W.	26	12	13	Easily lowered.

[a] Reduced three times; 2 inches at bottom.

Artesian water.—There are no deep artesian wells in this county, but many shallow flowing wells are found in the southern townships south of the area treated in this report.

The deep flow reached at a depth of 923 feet in the new well at Lynch, Boyd County, should, if tapped at Whiting bridge, have pressure sufficient to raise the water 75 feet or more above the river. According to barometric readings this would lack about 45 or 50 feet of reaching the river level at the Badger bridge. But since there is a gradual increase in pressure to the west, it is quite probable that a fair flow could be obtained at Badger at a depth of somewhat over 1,100 feet, and on the same basis it appears likely that the water would rise to the river level as far west as the mouth of the Keyapaha River and probably farther.

BOYD COUNTY.

The water conditions in Boyd County present considerable variety, owing to the diversity of the geologic formations. These comprise surface alluvial deposits, Tertiary sands, Pierre clay, and the Niobrara chalk rock.

Streams.—Missouri River receives several unimportant tributaries in the northeastern part of the county, draining an area of approximately 50 square miles of hilly country. The Niobrara flows with steep grade along the southern border of the county, draining a narrow district of approximately 125 square miles and a much larger area in Holt County. This water is used for stock and to some extent for domestic purposes, especially where a suitable supply can not be had from springs and wells. Keyapaha River, a tributary of the Niobrara, flows through a grazing country and is an important source of stock water. The conditions along this stream are favorable for small power sites. Ponca Creek, though having but a weak flow, drains more than half of the county. Its lower course is quickly affected by storm water, owing to extensive slopes of gumbo, or Pierre clay. It heads in broad, shallow sloughs in Gregory County, S. Dak., and in the high lands of Boyd County receives small amounts of ground water and a limited supply from direct run-off. Between Spencer and Butte there are successive terraces at rather regular intervals along the valley, which afford a good supply of spring and well water. Here many of the weak tributaries begin in elliptical holes and ponds in shallow sloughs. Ponca Creek affords good stock water. It has been used successfully as a source of mill power.

Springs.—The source of spring water here, as in Holt County, is the ground water in the Tertiary and terrace sands and gravels. Springs occur in large numbers; for example, on the SE. ¼ sec. 8, T. 34, R. 16 W., there are 25 springs, and on sec. 5, adjoining, a shallow cut developed a supply of water that flowed a distance of 120 rods.

The supply of water for Spencer is obtained from springs which come out of terrace sands and gravel three-fourths of a mile northwest of the town. The water is collected in a reservoir at the highest possible level and then pumped to a standpipe. Spring water is piped

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into a house in Lynch. All along Ponca Creek above Bristow springs issue from sand just above clay, and similar conditions exist along all of the principal streams of the county, especially the Keyapaha in the region of Twin Buttes.

Shallow wells.—The well-water supply of Boyd County has been reported as limited and bad, but, while it is true that some farmers have to haul water and that certain small towns have a poor supply, such cases are exceptional. Much alkali water is found in Pierre clay areas, but a large amount of soft water is obtained from Tertiary sand. Many of the gravels yield hard water, and the supply from the chalk rock seldom is satisfactory. Since the central and eastern parts of the county present a variety of surface formations, there are frequent differences in the quality of the underground water. In the area of Pierre shale, where the soil often is satisfactory for crop raising, the water is nearly always bad, but ordinarily it is practicable to locate the farm house on some other formation which will yield good well water. In locating wells it is advisable to prospect in sandy soil with small augers, and in sinking it is best to stop as soon as gumbo is reached, unless a cemented reservoir is to be constructed, for the alkali is dissolved from the clay by the water while it stands in the well. It has been observed that heavy pumping improves the quality of water in wells sunk through sand into the clay. Dry wells are not numerous and probably they occur only where the surface of the impervious clay rises above the ground-water level. Ordinarily such areas are of small extent, and trial borings will indicate their limits.

At Butte good and bad waters occur within a few rods. The water-bearing sands lie in depressions and yield a suitable and an abundant supply. In intervening areas the wells extend into gumbo and yield scanty supplies of poor water. If necessary an abundance of desirable water can be piped from wells near the buttes just south of town. At Monowi the wells are not favorably located, and the result is unsatisfactory. The supply at Gross is usually good.

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Representative shallow wells of Boyd County, Nebr.

Owner.	Location.	Depth.	Diameter.	Depth of water.	Quality.	Remarks.
		Feet.	*Inches.*	*Feet.*		
Hamilton place	Sec. 36, T. 32, N. R. 9 W.	22	20	9	Soft	
Chris Johnson	Sec. 24, T. 32, R. 10	25	18	5	Bad	Limited supply. Soil, sand, gravel, Pierre clay.
Charles W. Orr	Sec. 33, T. 34, R. 10	15	36	4	Hard, good	
C. C. Irwin	Sec. 14, T. 33, R. 10	24	16	9	do	Soil, sand, gravel.
J. C. Hoffman	Sec. 14, T. 33, R. 10	21	36	3	do	Sand and gravel.
Hubert Van Pelt	Sec. 14, T. 33, R. 10	22	12	5	do	Soil, sand, gravel. Limited supply.
B. Baker	Sec. 2, T. 32, R. 10	12	60	6	Hard, fair	Soil, weathered Pierre clay.
Albert Gillman	Sec. 2, T. 33, R. 10	22	36	10	Hard, poor	Soil, sand, weathered Pierre clay. Limited supply.
F. P. Mark	Sec. 34, T. 34, R. 10	24	24	16	Medium hard, good	Sandy loam, clay, sand.
John W. Orr	Sec. 21, T. 34, R. 10	30	24	8	do	Soil, clay, native lime, sand, and gravel.
C. A. Dean	Sec. 19, T. 34, R. 10	89	18	10	do	Soil, sand, clay, sand.
F. M. Stumbo	Sec. 20, T. 34, R. 10	44	28	16	Soft good	Water in 16 feet of gravel under 24 feet of Tertiary marl.
P. Carroll	Sec. 29, T. 34, R. 10	22	12	12	Hard, good	
Joseph Crowe	Sec. 22, T. 34, R. 10	16	36	4½	Soft, fair	
I. Jonason	Sec. 25, T. 33, R. 11	48	36	3½	Soft, good	Water in sand.
W. T. Reshaw	Sec. 18, T. 33, R. 11	66	24	7	Medium hard	Very cold water in thin bed of sand.
A. Fulckrod	Sec. 9, T. 33, R. 11	11	36	6	Poor	
Wm. Seeley	Sec. 18, T. 33, R. 11	66	24	6	Alkaline, bad	Soil, Pierre clay.
Martin Laugon	Sec. 19, T. 33, R. 11	36	4	13	Medium hard, fair	
Henry Wagoner	Sec. 28, T. 34, R. 11	33	36	10	Soft, good	
W. J. Everett	Sec. 2, T. 35, R. 11	32	24	6	Soft	Water in gravel under 21 feet of sand.
W. T. Reshaw	Sec. 35, T. 33, R. 12	30	16	15	Medium hard, bad	Poor water; not used; in Pierre.
L. S. Anger	Sec. 34, T. 34, R. 12	45	12	4	Soft	Soil, sand and gravel.
M. Coleman	SE. ¼ sec. 35, T. 33, R. 12	24	36	12	do	Soil, sand, and thick white chalk.
W. E. Kloke	NE. ¼ sec. 35, T. 33, R. 12	21	12	9	do	Soil, hard-pan soil, putty rock 8-9 inches; gravel, 1 foot; quicksand, 6 feet.
I. N. Morrison	NW. ¼ sec. 10, T. 34, R. 12	13	36	8	Medium	Soil and sand.
J. D. Schmidt	Sec. 22, T. 33, R. 12	32	12	8	Soft	Soil, sand, and gravel. Just to Pierre.
S. C. Claucus	Sec. 6, T. 33, R. 12	18	13	10	do	Soil, sand, and gravel.
W. S. Eaton	SE. ¼ sec. 30, T. 34, R. 12	41	26	6	do	Black soil, 3-4 feet; sand and gravel, 5-6 feet; clear sand, quicksand.
John Lampman	NW. ¼ sec. 31, T. 34, R. 12	32	38	8½	Hard	Soil, sand, white chalky clay.
O. R. Carmidrall	SW. ¼ sec. 31, T. 34, R. 13	75	15	15	do	Clay, rest magnesia. Some gravel in bottom.
A. D. Prattyman	NW. ¼ sec. 6, T. 33, R. 13	70	36	12	Soft	Soil and clay subsoil (light). Did not reach soapstone.
J. P. Ross	Sec. 24, T. 33, R. 13	36	10	9	Hard	Soil, sand, and gravel. Water in gravel.
C. E. Whittig	NW. ¼ sec. 15, T. 34, R. 13	32	16	10	do	Clay, gravel, and quicksand.
Elrich Windmyer	SE. ¼ sec. 21, T. 34, R. 13	50	18	25	Soft	Soil, light-colored, sandy clay. Did not reach soapstone.
John Webber	Sec. 36, T. 33, R. 13	10	48	5	do	Soil and sand.
J. D. Garmley	NW. ¼ sec. 29, T. 34, R. 13	33	36	10	do	Soil, 5 feet; sand, 12 feet; magnesian clay, 20 feet; sand and gravel.
J. Gamley	Sec. 25, T. 34, R. 14	43	48	16	do	Soil and loam, 10 feet; clay, 30 feet; sand and gravel.
G. S. Wright	NE. ¼ sec. 21, T. 34, R. 14	32	22	16	Medium hard	Soil, clay, subsoil, sand.
Ed McKemper	Sec. 30, T. 35, R. 16	125	12	15	Soft	Water in 14 feet; sand and gravel under 110 feet of Tertiary marls and sands.
Dwight E. Brown	SE. ¼ sec. 8, T. 34, R. 16	33	16	10	do	Soil and clay.
Jacob Heimerdinger	SW. ¼ sec. 11, T. 34, R. 16	15	48	10	Hard, good	Clay, 4 feet; balance in a flinty rock.

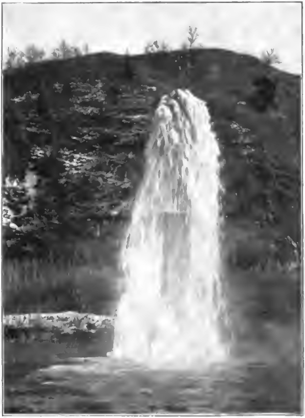
Artesian wells.—All of Boyd County is underlain by Dakota sandstone containing artesian water, but only a limited area is low enough for surface flows. Strong wells can be obtained along the Missouri bottom and along the Ponca Valley at least as far west as Spencer. The heavy pressure in the deep well recently finished at Lynch demonstrates that there is a deeper and stronger flow there, and probably that artesian wells can be had farther up Ponca Creek and Niobrara River than was formerly supposed. A deep flow was reached at Lynch, which has sufficient pressure to raise water to an altitude of 1,590 feet. This indicates that a surface flow can be obtained in the valley below Spencer, at a depth of about 1,065 feet. If the pressure increases westward across Boyd County a flow may be had in the valley below Anoka at a depth of about 1,170 feet, and as far west along the Niobrara bottom as the Badger Bridge and probably farther. Wells far to the west are more expensive to bore on account of increased depth and will afford little water power.

The wells at Lynch throw much light on the underground conditions. In the old well, completed in 1900, it is reported that at the top there were 260 feet, mostly "soapstone," 40 feet of Niobrara chalk rock at the base of the Niobrara formation, 275 feet of "soapstone" with some hard layers, 25 feet of hard rock and "sandstone" (presumably Greenhorn limestone), 20 feet of soapstone and clay, 50 feet of slate with coaly layers, 4 feet of so-called coal, 38 feet of sandstone, 30 feet of hard clay and sandstone, and 18 feet of porous sandstone in which the flow began. Other flows appeared in sandstones below until, at 797 feet, the flow was so strong that work was discontinued. The flow was 465 gallons a minute, pressure 52 pounds, temperature 79½° F., and diameter 6 to 4½ inches. In the new well bored in 1903 a pressure of 85 pounds is reported and a yield of 3,100 gallons a minute. The large flow in the new well is somewhat spasmodic in pressure and it has also thrown out considerable sand. It is to be used for mill power. The first flow was at 740 feet and the third at 875 feet; the temperature is 90°, and the diameter is 10 inches to 350 feet and 8 inches below. This well is shown in Pl. X.

Section of the new artesian well at Lynch, Boyd County, Nebr.

	Feet.
Sand and gravel	0- 18
Pierre clay (called soapstone)	18-105
Niobrara chalk rock, sandy and hard below	105-300
Carlile clays, with some beds of pyrites	300-588
Greenhorn limestone	588-610
Graneros clays and shales	610-700
Dakota sandstone and clay, alternating. Four or five different flows reported	700-923

Total depth 923 feet. Altitude of mouth, 1,392 feet.



SECOND ARTESIAN WELL AT LYNCH, NEBR.

Analyses of waters of artesian wells at Lynch, Nebr.[a]

[Parts per million.]

	8-inch or new well.	4-inch or old well.
Combined water and organic matter	233	232
Silica (SiO_2)	56	16
Iron and alumina (Fe_2O_3 and Al_2O_3)	10	2.8
Calcium (Ca)	251	255
Magnesium (Mg)	39	57
Sodium (Na)	46	52
Potassium (K)	12	15
Sulphate radicle (SO_4)	682	667
Carbonate radicle (CO_3)	75	67
Chlorine (Cl)	74	61
Total solids	1,474	144

[a] S. Avery and A. Jacobsen, analysts.

A well is now (1905) being drilled on sec. 33, T. 34, R. 11, near Rosedale, but the drill is fast at a depth of 793 feet. If boring is continued, a good well may be obtained at a depth of 1,100 to 1,200 feet. The first mill well at Lynch was three years in boring. The following altitudes, obtained from the Chicago and Northwestern Railway and by the use of an aneroid barometer, may be of value in considering the depth and head of the artesian waters:

Altitudes on line of Chicago and Northwestern Railway.

	Feet.
Monowi [a]	1,322½
Lynch [a]	1,400½
Spencer [a]	1,541½
Anoka [a]	1,638½
Fairfax, S. Dak.[a]	1,932½
Niobrara River at Whiting Bridge	1,502
Niobrara River at Badger Bridge	1,635
Missouri River at Greenwood	1,229
Missouri River at Fort Randall	1,240
Town of Spencer	1,637
Town of Butte	1,795

KNOX COUNTY.

Loess, varying in thickness from a few feet to over 100 feet, forms the surface over most of Knox County, its continuity being interrupted by a sandy area west of Verdigris Creek, by a clayey region beyond the Niobrara, by sandy sections near Santee, and by places where deeper valleys cut through to underlying formations. The northern and central parts of the county are somewhat hilly, and lower than the more level regions to the south and southeast. There is considerable bottom land along the Missouri and the Niobrara. The chalk rock so prominently exposed along the Missouri extends southward under the Pierre, Tertiary, Glacial, and loess deposits.

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[a] Base of rail at station.

In much of the county the Pierre clay and Niobrara chalk rock, which usually afford an inferior supply of water, are deeply buried by other formations and are not reached in ordinary wells. Except for an area of about 60 square miles draining south to Elkhorn River, the general slope and drainage is northward to the Missouri.

Streams and water power.—The Missouri is the most important stream; it flows along the northern margin of the county and is often the source of local water supply. The Niobrara River receives 7 tributaries of some importance from the south, but practically none from the north. Verdigris Creek, with a drainage basin of about 250 square miles, is one of the best water-power streams in northern Nebraska, gaging about 105 second-feet and flowing throughout the year. A mill is successfully run by water power from this stream at the town of Verdigre; the dam is constructed of greenish quartzite obtained 6 or 7 miles southwest. Several other good power sites exist between Verdigre and Niobrara River.

Bazile Creek closely resembles the Verdigris in character, but has a drainage basin in the center of the county, of about 400 square miles in area. Much of the power here is not favorably located with respect to railroads, but it might be transmitted to Creighton, Bloomfield, Winnetoon, and other towns. There are two well-constructed dams along the creek, one at the Bazile mill and the other at the lower Bazile mill (see Pl. XI, *B*). Each dam has a fall of about 12 feet and is made of greenish quartzite and each supplies water for 60-barrel flouring mill. Farther downstream numerous favorable power sites could be located.

Frankforter Creek, frequently called Weigand Creek, in the northeastern part of the county, is too weak for power, especially during the drier months.

Springs.—The rainfall accumulates as ground water in the loess and sand and gravel deposits, and from these springs issue, especially at the contact with impervious beds. Many flow from the outcropping edge of the top of the Pierre clay, which extends along the sides of the valley slopes. Talus from later formations often covers the clay more or less in the outcrops and sometimes carries the spring water to lower levels. In some parts of the county the upper surface of the clay is very uneven as a result of erosion.

As in adjacent counties the number of springs is very great, practically every little ravine along the Niobrara, Verdigris, and Bazile valleys being fed by a spring, large or small. Only a few can be noted: Springs just southwest and northwest of Verdigre could be piped to furnish an abundance of water for the town. The La Mont Springs, about 2 miles south of Niobrara, are quite strong. A spring at the place of R. F. Stout, sec. 5, T. 30, R. 5 W., south of Center, is

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A. OLD WELL AT SANTEE AGENCY, NEBR.

B. LOWER DAM ON BAZILE CREEK, KNOX COUNTY, NEBR. BUILT OF QUARTZITE.

piped some 350 yards to a hydrant at the house; the water, temperature 55½° F., issues from the base of coarse sand at the clay contact, at an altitude of about 1,525 feet, or 35 feet above the hydrant. A notably heavy spring is located 1½ miles southeast of Center. A small spring near the creek at the lower Bazile mill yields a good quality of drinking water; the flow is 7 gallons per minute, and the temperature 54½°. Several springs are found along the Frankforter Creek; one at Weigand affords a good supply of water for a public watering place, stock, and house use.

Shallow wells.—North of Niobrara and in the Ponca basin the shallow-water conditions are very variable; the best supplies are obtained from irregular areas of sand and gravel on the divides and from the flood-plain deposits. In the southwestern part of the county water is derived from Tertiary sands in wells from 100 to 200 feet deep. In the central, southern, and eastern portions good water is obtained in gravel, which often lies 175 feet deep on high ridges and table lands, and 20 to 35 feet in the old northwest-southeast valley extending from Verdigris Creek past Winnetoon and Creighton to the southeast. At a few places Tertiary sands rise above the gravel beds and afford a supply at less depths. Many blowing wells are found in Tps. 29 and 30, Rs. 2, 3, and 4.

The Pierre clay has not been reached in wells over 200 feet deep on the high lands south of Bloomfield, which indicates a great thickness of post-Cretaceous formations, many of them water-bearing. Over much of the eastern half of the county two gravel beds, separated by clay and sand, are encountered, except where they have been removed by erosion or where Tertiary sands rise above them.

In this county, as elsewhere, the water derived from wells extending into the Pierre clay and the Niobrara chalk rock usually contains much alkali, unless the beds have lost their soluble matter by leaching. Usually, not far from places underlain by these formations, good water may be obtained from alluvial or other sands.

Artesian wells.—Large supplies of artesian waters are available in all of the lower lands of the county, and in many places the conditions are favorable for high-pressure wells. The mill well at Niobrara, used so successfully for power, indicates that such wells might be obtained at many points on the Missouri, Niobrara, and Ponca bottoms. With little doubt one or more stronger flows can be had at a slightly greater depth, and an attempt is now being made at the Niobrara mill to reach one of these; the last report (1905) indicates slow progress in the drilling and a depth of 500 feet.

Representative shallow wells of Knox County, Nebr.

Owner.	Location.	Depth.	Diameter.	Depth to water.	Quality.	Remarks.
		Feet.	*Inches.*	*Feet.*		
[illegible] Cleveland	Sec. 28, T. 29 N., R. [illegible]	80	4	9		Clay, 80 feet; gravel and sand, 65 feet, clay, 40 feet; gravel, 1 foot.
Jack [illegible]	Sec. [illegible], T. 29, R. 4	18	4	4	Soft	Yellow clay, 80 feet sand, 60 feet; dry quicksand, 23 feet; dry gravel, 13 feet, hard pan, 4 feet, gravel, 4 feet.
D. C. Balleck	Sec. 26, T. 29, R. 3	152	..	30		Loess, 120 feet, sand, 18 feet; dry gravel, 24 feet; yellow clay, 8 feet; water gravel, 8 feet.
W. H. Wort	Sec. 26, T. 29, R. 5	30	1½	10	Soft.	25 to 28 feet sandy loam; sand, quicksand, gravel.
(In town)	Sec. 7, T. 30, R. 3	20	2	4	...	
Colin Valentine	Sec. 11, T. 30, R. [illegible]	40	30	32	Soft	
Peter Ward	Sec. 1, T. 30, R. 4	126		2	do.	Blue clay—some sand and gravel.
John Roberts	Sec. 3, T. 30, R. 4	90		Dry.	...	15 feet of black soil and rest mostly sand; coarse gravel in bottom.
John Tucker	Sec. 3, T. 30, R. 4	137			Hard	Black soil and sand with some clay.
John Roberts	Sec. 4, T. 30, R. 4	160		Varies.	do.	50 feet black soil and rest dry sand; water easily lowered, but quite steady supply.
Louis Eggert	Sec. 8, T. 30, R. 4	102		2	do.	Black soil on top, sand and gravel below.
Charles Ward	Sec. 9, T. 30, R. 4	140		12	do.	Sand and gravel, little clay; water supply not steady; easily lowered at times.
I. Ellingson	Sec. 4, T. 30, R. 5	16		9		Sand and gravel; well in bottom above creek.
W. D. Patton	Sec. 35, T. 31, R. 3	14	3×4	3		
J. B. Crockett	NE. ¼ sec. 21, T. 31, R. 4	57		15	Hard	Soil, bluish clay, gravel and water. Blowing well.
Frank Hajek	Sec. 8, T. 31, R. 5	30	16	6	Soft	Soil, sand to soapstone.
Frank Jelenek	Sec. 5, T. 31, R. 5 (in town)	17	12	3	do	Soil, sand and water in gravel.
F. P. Krolop	NW. ¼ sec 12, T. 32, R. 8	18	18	10	Medium	Soil, sand, 2 feet; gravel, 2 feet; soapstone rest of distance.
Chris. Johnson	Sec. 28, T. 32, R. 8	8	36	4	do	Soil, 4 feet; sand, sand and gravel.
J. H. Rothwell	Sec. 25, T. 32, R. 8	35	1½	10	Hard	Soil; reddish clay, 25 feet; gravel.
M. Thompson	Sec. 18, T. 32, R. 6	21	2	10	Soft	Soil and sand. In Niobrara Valley.
J. A. Lindsan	Sec. 16, T. 32, R. 6	14	2	3	do	Black soil, 5 feet; sand, 9 feet.
L. Weigand	Sec. 1, T. 32, R. 3	24	24	10	do	Soil, clay, then water.
C. H. Sawyer	NE. ¼ sec. 7, T. 32, R. 3	40	36	9	Medium	Soil, loess, 35; sand and gravel with water.
Frank Weigand	NE. ¼ sec. 10, T. 32, R. 3	42	24	8	do	Soil, loess 6; sand and gravel.
Chas. Jancore	Sec. 7, T. 32, R. 3	125	24			
James Renner	W. ½ sec. 23, T. 32, R. 3	24	36	15	Hard	Soil, sand and gravel. In small valley.
School	Sec 13, T. 33, R. 5	80		6	Alkaline	6 feet into chalk rock.
Charles Jacocks	Sec. 11, T. 32, R. 3 W	130	36	5	Hard	Soil, loess and sand (?).
D. C. Cleveland	5½ miles east of Creighton					Sandy loess, 75; gravel, 80; fine sand, 10.

A new well is soon to be put down at the Santee Agency. The old well there, which has been used successfully for mill power, irrigation, fire protection, and general water supply, is now of little use (see Pl. XI, *A*), because the casing has rusted off 2 or 3 feet below ground. The large well at the school afforded clear water for about two weeks when finished, and the volume was at first over 2,000 gallons per minute. After a while it began throwing out sand and shale, and the flow ceased entirely a few times but was started again each time by cleaning. At present the pressure is 26½ pounds at the mouth of the well, which is 105 feet above Missouri River. In this well trouble was experienced with the casing at a depth of about 500 feet. The present water supply is thought to come principally from the first flow. Wells in the northeastern part of the county have decreased in pressure and flow, principally because they were not properly cased.

Attempts to get wells on high lands have failed because of the altitude, the pressure, though strong in the water-bearing beds below, not being sufficient to force the water to the height necessary.

Record of well at the packing house, Niobrara, on the Missouri bottom, sec. 8, T. 32, R. 6 W.

	Feet.
Soil and sand	0– 70
Niobrara chalk rock	70–200
Clays and shales with thin beds of iron pyrites (Carlile)	200–410
Limestone (Greenhorn)	410–442
Clay and shale (Graneros)	442–520
Dakota sandstone and clay	520–600

Record of small well at the school, Santee, Nebr., sec. 13, T. 33, R. 5 W.

[Mouth of well 143 feet above the Missouri River.]

	Feet.
Soil and sand	0 – 23
Pierre clay	23 – 35
Niobrara chalk rock	35 –240
Clay, shale, and thin beds of iron pyrites (Carlile)	240 –445½
Limestone (Greenhorn)	445½–502
Clay and shale (Graneros)	502 –600
Dakota sandstone	600 –604

Record of John Lytle well, sec. 19, T. 33, R. 2 W., Nebraska.

[Mouth about 70 feet above the Missouri River.]

	Feet.
Soil	0– 6
Niobrara chalk rock	6– 88
Clays and shales with hard beds (Carlile)	88–380
Limestone (Greenhorn)	380–400
Clay and some shale (Graneros)	400–490
Dakota sandstone and clay (second flow)	490–530

Artesian wells of Knox County, Nebr.

Name.	Location.	Diameter.	Depth.	When drilled.	Pressure when drilled.	Yield per minute.	Temperature.	Remarks.
		Inches.	*Feet.*		*Pounds.*	*Gallons.*	*F.°*	
Dan's well, Hiles ranch.	1¼ miles east of Monowi, sec. 18, T. 33, R. 8 W.	3-2	770	1895			70	Pressure now 11 pounds, with leak. Third flow, 740 feet. Temperature varies.
O. Hegen	7 miles west of Niobrara, sec. 21, T. 32, R. 7 W.	2	500	1903				A surface flow is not expected. Depth given is for Aug. 15, 1903.
Mrs. John Havlicek.	Near Verdigris, sec. 29, T. 31, R. 6. W.	2	770	1896	Formerly 34, now 11.	14 now	74½	
Niobrara mill well	Niobrara	8	656	1896	At first 95	1,900	68	Pressure July 14, 1903, 65 pounds when not entirely shut off. Pressure 120 pounds when closed 2 weeks in 1896.
Niobrara packing-house well.	do.	2	600	1895	Reported 107	Was 280	66	Pressure weak now with leak; also yields about 35 gallons per minute.
Foreman ranch	4 miles east of Niobrara, sec. 12. T. 32, R. 6 W.	2	548	1903	82	240	65	Principal flow at 520 feet.
Large school well	Santee, sec. 13, T. 33, R. 5 W.	8	740	1899	55 when drilled, 26½ now.	1,699 when drilled, 106.2 cubic feet now.	64	Mouth of well 105 feet above Missouri River.
Small school well	do.	3	604	1885	Very weak		64½	This water is piped through houses.
Agency well	do.	6	600		Weak		64	Not much used now. Leaks at break in pipe.
Herrick ranch well	2 miles west of Herrick. sec. 16, T. 33, R. 3 W.	2	400		Was strong, weak now.	8	62	Pipe badly rusted. On Missouri bottom.
Clark well (formerly Brown).	1½ miles northwest of Herrick, sec. 15, T. 33, R. 3 W.	2	400		Weak		61	On bottom land. Cased the second time.
T. C. Van Meter	Sec. 13, T. 33, R. 3 W	2	504	1892	Not strong	2	63	On high ground.
John Lytle	Sec. 19, T. 33, R. 2 W	2	550	1899		10	63½	About 70 feet above the Missouri River.
C. D. Buhrow	Sec. 20, T. 33, R. 2 W	6	650	1894	64 when drilled, ceased flowing this summer.	30 with big leak	62	Up Frankforter Creek. Diameter below 44 feet is 4½ inches.
Lytle ranch well	Sec. 17, T. 33, R. 2 W	2,3	400	1887	25½ with big leak	3	62½	Passed through 10 feet of bowlders at depth of 50 feet. Formerly had high pressure.
Mastin Mische	E. ½ sec. 20, T. 33, R. 2 W.	2	600		Weak now, was very strong.	6	62	About 70 feet above the Missouri River.
Kate Phelps well	SE. ¼ sec. 16, T. 33, R. 2 W.	1	400		11	3	62	On Missouri bottom.
John Mische	do.	2	395		Weak	9	60	On Missouri bottom, near chalk bluff.
Chas. Mische, lot well.	Sec. 15, T. 33, R. 2 W	2	405		14 now, with leak.		59½	Part way up chalk bluff.
A. P. Sage	Sec. 13, T. 33, R. 2 W	2	700		Does not flow			Used as a tubular well; 200 feet above river.
Chas. Mische	Sec. 15, T. 33, R. 2 W	2	425		14 now, with leak.	9	61	Part way up chalk bluff.

CEDAR COUNTY.

The most extensive surface deposit in Cedar County is the loess, below which lie Quaternary and Tertiary sands, clay, and gravel. Of the Cretaceous formations only a few detached areas of Pierre clay occur, while Niobrara chalk rock underlies all of the county, either beneath later formations or at the surface. The other members of the Cretaceous exposed along the Missouri lie at lower levels beneath the chalk.

The surface of the county is for the most part gently rolling, with drainage to the northeast and southeast. The principal streams, aside from the Missouri, are Bow and West Bow creeks, which converge north of St. James. The southern and southeastern townships are drained by Logan Creek.

Springs.—The big springs near Coleridge were well known in the early history of the county as a watering place for immigrants. Curlew Springs, issuing from banks beneath the drift in a boggy slough, are also well known. The Frank Hochstein Spring on sec. 8, T. 32, R. 2, is perhaps the finest in the county. It is located at the foot of a loess-capped hill and the water boils up from a circular hole the depth of which has not been ascertained. The flow is between 400 and 500 gallons per minute, which, according to the owner, has not changed in thirty-eight years. The water deposits some iron and on that account is usually regarded as coming from the artesian supply. The temperature is only 50½°. The water is used for drinking, domestic and dairy purposes, and stock.

Shallow wells.—In this county there is usually an abundance of good water available in shallow wells, from Tertiary and Glacial sands and gravels. In some localities the wells extend into the chalk rock, which gives very hard water but contains less alkali than farther west, the formation appearing to be leached out in this county. Not many shallow wells are found along the Missouri bottom, the water supply there being derived from artesian wells.

The depth of common or shallow wells is controlled to a considerable degree by the topography. In the broad valleys water is obtained at a depth of a few feet, usually from 10 to 40, while on some of the intervening ridges and high lands the depth to it is considerably greater.

About Hartington the depths vary from about 15 to 35 feet and at Coleridge from 20 to 45 feet.

Representative shallow wells of Cedar County, Nebr.

Owner.	Location.	Depth.	Diameter.	Depth of water.	Quality.	Remarks.
		Feet.	*Inches.*	*Feet.*		
Chas. Clark	Sec. 21, T. 33 N., R. 1 W.	60	24	15	Hard	Soil, clay 20–30 feet; chalk rock.
James Marsh	Sec. 16, T. 33, R. 1 W	72	24	20	do	Good drinking; soil, clay; chalk rock.
Town well	Sec. 16, T. 33, R. 1 W	70	60	11	Medium	Soil to 12 feet; sand; soil; gravel with water.
H. Wubben	NE¼ sec. 23, T. 33, R. 1 E.	100	36		Hard	Soil; loess 30 feet; red chalk rock 20 feet; blue chalk 48 feet.
Carl Doeller	Sec. 35, T. 33, R. 1 E	50	48	2	do	Soil; loess 44 feet; chalk.
L. P. Lauretzen	Sec. 26, T. 32, R. 2 E	50	48	10	do	
Ernest Ferber	Sec. 1, T. 31, R. 2 E	36	2			Black dirt 3 feet; sand 22 feet; balance gravel.
W. H. Hight	Sec. 9, T. 29, R. 2 E	13	30	9	Medium.	Soil, gumbo; sand in bottom.
Ed Fiscus	Sec. 18, T. 29, R. 3 E	55	2¼		Hard	Soil, silty; loess 51 feet; sand with water at bottom.
R. C. Chase	Sec. 34, T. 30, R. 3 E		30		do	Loess, sand, and gravel; is 60 feet below highest hills.

Artesian wells.—There are nearly 100 flowing artesian wells in Cedar County, all of which are either along or near the Missouri bottom. Their distribution is shown on Pl. IX (in pocket), and most of their features are given in the table, page 47. In addition to these there are many tubular wells on the highlands to the south, some of which flowed for a short time. The supply in these tubular wells comes from the artesian water in the Dakota sandstone and rises as high in these wells as it would in pipes at artesian wells on the Missouri bottom. Mr. Chamberlain, who drilled most of the wells in Cedar County, states that flowing wells can be had up West Bow Creek for 7 miles and up Bow Creek for 6 miles from the river. Beyond that distance they cease to flow.

This important resource should be protected by more careful casing of wells; all should be cased to the cap rock and kept under control at the surface. As it is there is an enormous loss by underground leakage and the waste of flows on the surface.

Record of artesian well at St. Helena, Nebr.

	Feet.
Chalky limestone	0– 25
Shale	25– 59
Dark blue clay	59–329
Shale	329–369
Black shale with hard layers and lignite 6 inches thick at 399 and 418 feet	369–418
Sand with flow, underlain by clay	418–466

Owner.	Location.	Depth.	Diameter.	When drilled.	Pressure.	Yield per minute.	Temperature.	Remarks.
		Feet.	*Inches.*		*Pounds.*	*Gallons.*	*° F.*	
Frans Nelson	NW. ¼ sec. 17, T. 33, R. 1 W	500	1½		Weak		59	Soil; chalk to perhaps a little below the river clay, hard beds, and shale to sand rock.
Albert Miller	Sec. 18, T. 33, R. 1 W	648	3½		None			Water raised to within 56 feet of the surface about 200 feet above river.
D. Miller	NE. ¼ sec. 17, T. 33, R. 1 W	365	2	1898	15	26 at first	59½	Soil; sand 45 feet; no chalk: clay and shale for most of distance: thin cap rock with porous sand rock beneath: Flow at 337 feet.
John Nelson	SW. ¼ sec. 16, T. 33, R. 1 W	400	2	1883	Weak		59½	About 10 feet above river.
Do	SW. ¼ sec. 16, T. 33, R. 1 W	400	2		14	7 now	60	On Missouri bottom.
John Aten	Sec. 16, T. 33, R. 1 W	400	2	1896	9 now	7	58½	Do.
Eugene Saunders	SE. ¼ sec. 9, T. 33, R. 1 W	400	2	1896	8	7	58½	On Missouri bottom. Diameter reduced to 1 inch at top.
Joseph Holtzbauer	SE. ¼ sec. 10, T. 33, R. 1 W	400	2	1895	Strong	15	59	Soil and sand, 181 feet; clays, shale, and hard rock to water rock.
J. H. Coacher	SW. ¼ sec. 11, T. 33, R. 1 W	380	2					Rusted pipe. Used as tubular well.
John Nelson	Sec. 12, T. 33, R. 1 W	400	2		About 13	7	59½	Pressure was stronger.
L. Hoesing (Eikhoff well)	Sec. 30, T. 33, R. 1 W				None	Does not flow		On high ground. Tubular.
William Lackman	NE. ¼ sec. 27, T. 33, R. 1 W		2		do	do		Flowed for a time. Used as tubular well now.
Dave Nelson	Sec. 12, T. 33, R. 1 W	380	2	1897	Strong	44	60	
Albert Lee	Sec. 8, T. 33, R. 1 E	360	2	1896	Weak	78 when drilled; 52 now.	59½	Soil, 4 feet; quicksand, 20 feet; coarse sand and gravel, 30 feet. The rest of the way blue clay, with few layers of hard rock ranging from 3 inches to 3 feet in thickness.
C. B. Clark	NW. ¼ sec. 17, T. 33, R. 1 E	420	2		Good		69	
H. Yager	Sec. 16, T. 33, R. 1 E	360	2	1889	Weak	5½	58	On Missouri bottom.
M. U. Hoyt	SW. ¼ sec. 17, T. 33, R. 1 E	454	1½	1893	Fairly strong		58½	Is used for the house, barn, and three pastures.
Dave Nelson	NE. ¼ sec. 15, T. 33, R. 1 E		1½	1892	Weak	40		On Missouri bottom.
Mrs. Mary Bruns	Sec. 23, T. 33, R. 1 E	500	1½		do			
Joe Baehmer	Sec. 22, T. 33, R. 1 E	500	2	1890	Ceased to flow			First flow at 290 feet; second flow at 500 feet.
Do	Sec. 22, T. 33, R. 1 E	500	2	1896	Strong	15 to 20	62	
George Housman	Sec. 24, T. 33, R. 1 E	350	2		Strong: was 35	Full pipe	60	
A. Tielke	Sec. 25, T. 33, R. 1 E	630			Does not flow	Does not flow		Temperature warm.
H. Brunig	Sec. 25, T. 33, R. 1 E	602	2	1894		At first 25; does not flow now.		Clay, 200 feet; limestone, 25 feet; clay, 60 feet; hard rock, 40 feet.
John Cooper	Sec 25, T. 33, R. 1 E	520	2		Was strong	Does not flow now		Temperature was warmer than shallow well.
Kate Housman	Sec. 30, T. 33, R. 1 E	530	2	1901	19	30 at first	63	
John Statman	Sec. 30, T. 33, R. 1 E	600	2					Flowed for short time only. Now used as tubular well.
M. C. Smidt	Sec. 32, T. 33, R. 1 E		2		None	Ceased to flow		Soil, etc., 20 to 30 feet; chalk; clay over 100 feet; hard rock; clay and shale, 100 feet; sand and sandstone. Ran out of pipe at 300 feet. Water lifted at 120 feet, but did not flow out.

Artesian wells of Cedar County, Nebr.—Continued.

Owner.	Location.	Depth.	Diameter.	When drilled.	Pressure.	Yield per minute.	Temperature.	Remarks.
		Feet.	*Inches.*		*Pounds.*	*Gallons.*	*° F.*	
T. N. Jones	Sec. 34, T. 33 N., R. 2 E	280	2	1893	Fairly strong	Pipe nearly full in horizontal position.	60	On Missouri bottom lands.
W. C. Jones	Sec. 28, T. 33, R. 2 E	420	2	1893	Strong		60½	
Do	Sec. 29, T. 33, R. 2 E	200	2	1896	do	Pipe nearly full	60½	
Do	Sec. 28, T. 33, R. 2 E	300	2			Ceased flowing		
Frank Arens	Sec. 34, T. 32, R. 1 E	535	3	1889		2		
B. Wubben	SW. ¼ sec. 5, T. 32, R. 2 E	500	2		Weak	4	61	
Do	SW. ¼ sec. 5, T. 32, R. 2 E	600	2, reduced to 1½ below.		At first 4	Weak at first, ceased flowing.		Passed through considerable chalk.
C. E. Klapping	Sec. 10, T. 32, R. 2 E		2		Weak		60½	
Frank Wiesler	Sec. 9, T. 32, R. 2 E		2		do	5	60	
Peter Hochstein	SW. ¼ sec. 8, T. 32, R. 2 E	530	2	1888	do	2	60½	
Ernest Ferber	NE. ¼ sec. 10, T. 32, R. 2 E	241	2	1886	do	Two 1¼-inch pipes full.	60	
T. N. Jones	NE. ¼ sec. 10, T. 32, R. 2 E	2	400	1890	Was 30, now 17 with leak.	Pipe full	60	First flow forced water 56 feet above the bottom, second flow strong, third stronger.
Jacob Kelzer	SE. ¼ sec. 9, T. 32, R. 2 E	2	500	1893	None now	Flows a little out of ditch 6 feet deep.		
August Hochstein	SW. ¼ sec. 10, T. 32, R. 2 E	2	360	1894	Strong	Horizontal pipe nearly full.	59	In Bow Creek Valley.
F. Ashbre	NE. ¼ sec. 12, T. 32, R. 2 E	2	300		do	11	59	
James Keegao	SE. ¼ sec. 14, T. 32, R. 2 E	2	400		Weak	1	60	
John Hochstein	NW. ¼ sec. 15, T. 32, R. 2 E	2	320		do	Size of finger flow	59	Do.
W. D. Schulte	NE. ¼ sec. 23, T. 32, R. 2 E	2	360	1887	30	60		
A. W. Jones	NE. ¼ sec. 11, T. 32, R. 2 E	2	417	1896	10	Flows horizontal pipe (2 inches) half full.	58	
Do	Sec. 11, T. 32, R. 2 E	2	300	1893	Could not gage	Flows 2-inch horizontal pipe.	58½	
Ferd Ashbre	NW. ¼ sec. 13, T. 32, R. 2 E	2	400		Weak		59	
St. James Well	NW. ¼ sec. 24, T. 32, R. 2 E	2	540		None	Does not flow now.		
Bert Thompson	NW. ¼ sec. 24, T. 32, R. 2 E	2	300		Weak	2½	59	
F. Leise	SE. ¼ sec. 25, T. 32, R. 2 E	2	340		do	2	58	
Do	Sec. 25, T. 32, R. 2 E	2	400		Was weak	Flow ceased		
Peter Kugan, Ashmole Well.	NE. ¼ sec. 14, T. 32, R. 2 E	2	520	1894	Strong	Flows horizontal pipe full.	62½	
Nels Anderson	Sec. 23, T. 32, R. 2 E	2	400	1888	Weak	30		
H. E. McKenzie	Sec. 24, T. 32, R. 2 E	2	448	1894				270 feet to water.
Jones-McKenzie	SE. ¼ sec. 7, T. 32, R. 3 E	2	40		16	Flows a 2-inch	61	At first flowed pipe full.

Richard Brewer	SW. ¼ sec. 8, T. 32, R. 3 E.	2	400	1900	Nearly 4 now	Runs 2-inch horizontal pipe nearly full.	60½	Pressure varies with season. Strong when drilled. Decreased six months after.
Do.	NE. ¼ sec. 8, T. 32, R. 3 E.	2	300	1893	Weak	1½	58¼	
H. Wiseman	SE. ¼ sec. 8, T. 32, R. 3 E.	(a)	280	1883	Could not determine.		58½	
T. W. Whitehouse	Sec. 9, T. 32, R. 3 E.	2						15 feet above river.
Riley Brewer	Sec. 9, T. 32, R. 3 E.	2	280			Runs ½ pipe full	59	
Mrs. L. Larson	SW. ¼ sec. 11, T. 32, R. 3 E.	2	280		None; was fairly strong.	None		Flow stopped in 1902, owing to rusted pipe.
S. Boyles	NE. ¼ sec. 15, T. 32, R. 3 E.	2	365		5	7	57	Well not well cared for. Overflows, forming a marshy pond.
Theodore Beste	SW. ¼ sec. 15, T. 32, R. 3 E.	2	310	1900	17	Good flow	60	
Do.	NE. ¼ sec. 15, T. 32, R. 3 E.	2	240		Weak	3	58	
Do.	NE. ¼ sec. 16, T. 32, R. 3 E.	2	270		do	4	58½	
Do.	SW. ¼ sec. 12, T. 32, R. 3 E.	2	310	1891	Weak now; 18 when drilled.	8	59½	
C. B. Larson	NW. ¼ sec. 15, T. 32, R. 3 E.	2	—300		1	1½ now	56	Overflows into pond or marshy place near house.
Nels Anderson	SW. ¼ sec. 21, T. 32, R. 3 E.	2			Just fair	3 or 4	59½	
Do.	NW. ¼ sec. 21, T. 32, R. 3 E.	2	340		Very weak	1	59	
Do.	NE. ¼ sec. 22, T. 32, R. 3 E.	2	400		None	No flow now		
Do.	Sec. 23, T. 32, R. 3 E.	2	400	1888		1 barrel		
Ferd Ashbre	Sec. 16, T. 32, R. 3 E.	2	40		Fair	5	59½	
Do.	Sec. 7, T. 32, R. 3 E.	2	300		Not strong		59	35 feet above river.
J. W. Gowery	Sec. 21, T. 32, R. 3 E.	2	327	1893	2		55½	
Do.	Sec. 21, T. 32, R. 3 E.	2	310		Weak	3	55	Just flows.
Herman Koch	NE. ¼ sec. 14, T. 32, R. 3 E.	2	270	1893	Could not gage	20	59¼	
Fred Riefenrath	SE. ¼ sec. 12, T. 32, R. 3 E.	2	250		Was 12	8	57	Drilled about 12 years ago.
Do.	NE. ¼ sec. 23, T. 32, R. 3 E.	2	530	1886	Weak now	12	59	When first drilled this well was the cause of considerable trouble between its owner and parties owning land over which the water flowed.
Frank Rolfenrath	SW. ¼ sec. 11, T. 32, R. 3 E.	2	245	1887	Could not gage	11	57½	Owner could not give log. Casing at first 1¼ inches; then 2 inches, and became strong again. Owner is 83 years old.
Chris Sartorius	SE. ¼ sec. 13, T. 32, R. 3 E.	2	255	1887		7		When first drilled volume 40 gallons per minute.
Swan Anderson	Sec. 24, T. 32, R. 3 E.	2	280		Weak	Enough to form quite a lake northwest of house.	69	Is piped to different lots about the barn. Runs in a large tile, 3 feet high, near the house. The pressure is little more than enough to lift the water to this level, as there is only a weak overflow. Temperature given was in the large tile.
J. C. Dawson	NE. ¼ sec. 24, T. 32, R. 3 E.	2				Horizontal pipe, 1 inch at top, full.	63½	
Do.	Sec. 24, T. 32, R. 3 E.	2	340	1890	Weak, pipe leaks	2	60	Much H_2S in water.
John Lammers	Sec. 35, T. 32, R. 3 E.	2	600	1885	Ceased flowing	All that 2-inch casing could hold.		

[a] 1½ inches, 1½ now.

DIXON COUNTY.

The southwestern part of Dixon County resembles adjacent parts of Cedar County in topography, structure, and water conditions. In most other portions, except on the bottom land and along the bluffs on the Missouri, loess-covered hills predominate. The amount of sand and gravel beneath the loess appears to decrease to the northeast. The northwestern part of the county is underlain by Niobrara chalk rock. Glacial clay appears to be more widely distributed than in Cedar County.

Very little difficulty is experienced in obtaining a good supply of water, the Benton clays being the only beds that yield well water unfit for use. The principal water-power stream, the Aowa, is not strong, but inexpensive dams at Ponca and Martinsburg, constructed of brush, stone, and soil, afford water power for flouring and grist mills.

Springs.—Many springs occur in the county, one of the most notable of which is at Waterbury, where the flow has been used for locomotives. The water here rises from a considerable depth into a large circular basin near the station. One-half mile south a similar spring 45 feet across and 20 feet deep, flows between 300 and 400 gallons of water a minute, never freezing over during winter.

The Hurley Springs, about 5 miles west of Martinsburg, come out of sands above bowlder clay at an altitude of 1,425 feet. South of this place there is a general seepage from the slope at an altitude of 1,500 feet.

Shallow wells.—Much of the domestic water supply is from very shallow wells, which are affected somewhat by dry weather. In several localities the water table comes so near the surface that flowing wells might be had. One well 45 feet deep, at the stock yards in Allen, overflows. At Allen the water rises to within 12 feet of the surface, from a bed of gravel which lies at a depth of 70 feet. The following representative wells show the prevailing conditions in this county:

Google

Representative shallow wells of Dixon County, Nebr.

Owner.	Location.	Depth.	Diameter.	Depth of water.	Quality.	Remarks.
		Feet.	*Inches.*	*Feet.*		
Town well of Wakefield	Sec. 32, T. 27 N., R. 5 E.	80	6	60	Very good, hard	Black loam 10 feet; clay 30 feet; gravel.
J. W. Hypse	Sec. 24, T. 27, R. 4 E.	104	2	80	Hard	Black loam 4 feet; clay, sand, and gravel 100 feet.
Peter Norell	Sec. 25, T. 27, R. 4 E.	67	36	25	Bad, hard	Loam 2 or 3 feet; red clay, gravel, blue clay.
G. A. Herrick	Sec. 33, T. 29, R. 6 E.	27	3½	7		
R. C. Caulk	Sec. 9, T. 28, R. 5 E.	266	5	56	Hard	Yellow clay 111 feet; 31 feet to dry sand; dry gravel 18 feet; sand rock 1½ feet; dry sand 30 feet; 30 feet water; clay and sand 2 feet; water gravel 26 feet; light yellow clay 8 inches.
Benson Grain Co	Sec. 26, T. 28, R. 6 E.	55	1½		do	
Ioderson	NW. ¼ sec. 11, T. 29, R. 4 E.	155				Soil and loess 10; sand 6; yellow clay 34; blue clay (granules) 100; sand and water 5 feet.
Maggie Hurley	NE. ¼ sec. 10, T. 29, R. 5 E.	71	5	30	Hard	Soil, sand, and gravel mixed with clay, 15 feet; soil; blue clay to water.
D. Hurley	NE. ¼ sec. 2, T. 29, R. 5 E.	45	6	18	do	Reached second water.
Lawrence Phillips	Sec. 7, T. 29, R. 5 E.	15	36	10	do	
Dennis Hurley	Sec. 10, T. 29, R. 5 E.	26	3½	22	do	Water in blue clay—affected very little in dry seasons.
Do	do	44	6	26		Can not be pumped dry.
J. E. Ekersoth	Sec. 22, T. 30, R. 6 E.	22	36	18	Hard	
Gilbert Bros	Sec. 28, T. 30, R. 3 E.	60	36	14	do	Soil, loess 40 feet; blue glacial clay 22 feet; sand and gravel.
A. Wiedenfeld	Sec. 6, T. 30, R. 4 E.	80	24	15		Loess 50 feet; cobblestone and gravel 5 feet; blue clay 25 feet.
Sam. Thomas	NW. ¼ sec. 24, T. 30, R. 4 E.	156		36		Loess 100 feet; sand 56 feet.
Nick Thomas	SW. ¼ sec. 12, T. 30, R. 4 E.	265		65		Loess 40, blue clay and sand 60, sand 150, and shaly clay 15 feet.
John Rahn	NW. ¼ sec. 34, T. 30, R. 5 E.	301		Many		Loess 60, blue clay (Benton) 210, sandstone with water (Dakota) 29 feet.
O. J. Anderson	NE. ¼ sec. 33, T. 32, R. 4 E.	167		10	Good	Loess 130, dry sand 11, sandy clay 8, and fine sand with water 18 feet.

Artesian wells.—There are a few artesian wells on the bottom lands in the northern part of the county. If wells were sunk to the lower beds of the Dakota formation and carefully cased, flows could be had several miles farther southeast. There are also a number of deep tubular wells located on high land south of the Missouri bottom. The following wells are now flowing:

Artesian wells of Dixon County, Nebr.

Name.	Location.	Depth.	Diameter.	Length of casing.	When drilled.	Pressure.	Yield per minute.	Temperature.	Remarks.
		Feet.	*Inches.*	*Feet.*		*Pounds.*	*Gallons.*	*F.°*	
Chris Sartorious	Sec. 19, T. 32 N., R. 4 E.	300	2	70.		Weak	2	61	Pipe leaks.
Fred Reifenrath	Sec. 19, T. 32, R. 4 E.	300	1½	65.		do.	2	61	Pipe rusted.
J. P. W[illegible]rnick	Sec. 29, T. 32, R. 4 E.	280	2	60.	1893	2 now	1	61	Pressure 8 pounds when drilled.
Do.	NE. ¼ sec. 29, T. 32, R. 4 E.	280	2	70.	1898	Weak (leaks)		60½	Flows pipe half full.
C. Weeks	Sec. 28, T. 32, R. 4 E.	290	2	At first 50; now 1-inch pipe to bottom.		5½		60¼	Flowed at 240 feet. Pressure 9 pounds when drilled.
Thomas Warnick	NW. ¼ sec. 28, T. 32, R. 4 E.	277	2	60.	1899	6 now; was 8		60¾	Sand, 70 feet; limestone and clay, 80 feet; sandstone and water. 27 feet.
Do.	Sec. 28, T. 32, R. 4 E.	177	2	60.	1901	Weak		59	Shallowest well in this region.
Butler Bros.	Sec. 34, T. 32. R. 4 E.	300	2			None	1	58	Pipe rusted off.
Dexter Rice	Sec. 28, T. 32, R. 5 E.	265	2	40.	1888	Nearly 10		61	Pressure 10 pounds when drilled. First flow at 160 feet.
T. J. Ryan	Sec. 32, T. 32, R. 5 E.	265	2	At top 3 inches in diameter.	1896	2 now	3	55	Pressure 8 pounds when drilled.
Do.	Sec. 32, T. 32, R. 5 E.	400	2		1886	12½ originally	3	54	Flowed 50 gallons when drilled.
Geo. Mathison	Sec. 20, T. 31, R. 6 E.	484	3		1888	None			Flowed 3 weeks. Rises within 3 feet of top.

DAKOTA COUNTY.

Dakota County resembles Dixon in configuration but includes a much wider area of bottom lands along the Missouri. Its uplands are deeply trenched by the small valleys of many watercourses, with the intervening ridges or plateau remnants thickly capped by löess. Cretaceous rocks from Dakota to Greenhorn appear in the slopes and often present extensive outcrops. The Missouri bottom land is thickly floored by alluvial deposits.

The principal stream is Missouri River, which defines the eastern boundary. There are several creeks of moderate size, the most notable of which is Elk Creek, a stream which flows with a remarkably crooked course north from Emerson to Goodwin, then east and southeast to Jackson, and finally southeast and east to the river northeast of Homer. There is much surface water, but the principal water supplies are from the numerous springs and shallow wells.

Springs.—Many springs issue from the Dakota sandstone, which outcrops from above Jackson to the southeastern part of the county. These afford an abundance of good cool water for drinking, domestic purposes, and stock. A spring in sec. 24, T. 28 N., R. 8 E., 2 miles northwest of Homer, has been used for forty-eight years for domestic supply and as a public watering place. It flows 6 gallons a minute, with a temperature of 51°.

The Miller Spring, a short distance northwest of Homer, is piped from a tile sunk in the sand; part of the flow fills a 1-inch pipe.

At a ranch a half mile north of Homer the sand rock has been dug into and a reservoir walled up, from which runs enough water to fill a 2-inch pipe. A half mile north of this place there is one of the strongest springs in the vicinity, and about 6 miles southwest of Jackson there are two very strong springs.

Wells.—Underground-water conditions are much the same as in Dixon County, except that the Dakota sandstone rises nearer to the surface and is easily reached by tubular wells. There are no artesian wells in the county; the artesian water reached in such wells farther west issues here as springs.

The following is the record of a tubular well on high ground 6 miles southwest of Jackson: Loess, 90 feet; sand and hard spongy clay, 6 feet; dark clay with a bed of limestone near the middle, 156 feet; sand rock with good water, 6 feet.

Wells on or near the bluffs between Jackson and Homer are usually 80 to 100 feet deep, but several in Jackson are deeper. The Ashford well at Homer is 184 feet deep. The supply is usually good, but in the Ashford well the water is poor on account of improper casing through clay beds which carry soluble salts. On the bottom lands the depth to the first water varies from 20 to 25 feet, but at 35 feet

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the water is usually poor. Formerly most wells were drilled to the greater depth, but now they are driven to the first water. According to reports by well drillers the alluvium southeast of Jackson is from 80 to 100 feet deep. A steady supply of good drinking water is obtained at Homer in a well 40 feet deep. In the southwestern part of the county wells are very shallow, but yield inexhaustible supplies.

AGRICULTURAL RESOURCES.

SOILS.

The soils of the region are of several types, having been formed by various agencies acting on rocks of different kinds; most of them are closely related to the underlying formations. Much of the eastern and central parts of the area lies in the fertile loess region, where the soil is deep and easily worked, receives and holds moisture well, and yields heavy crops on both hilly and level lands. The alluvial bottom-land or flood-plain soil is also fertile and easily tilled, but in the lowest areas fields are often damaged by high waters and by shifting of the river channel. The heavy Pierre clay, or gumbo soil, is especially extensive in Boyd County; it contains some alkali and often affords bad water, but usually produces good grass and heavy yields of corn, oats, and wheat, especially where the clay is mixed with sand. The sandy upland soils in Cedar, Knox, Holt, and western Boyd counties stand droughts well and are gradually being utilized.

CROPS.

The principal crops are hay, corn, wheat, and oats, but alfalfa and sugar beets are also successfully grown. Mixed farming is practiced generally, except at points where the land is too sandy, or the topography is not favorable. Every county has a large acreage of hay land; in Cedar County this crop is grown principally along broad creek basins. While corn grows well throughout most of the region, it does best at certain points on the Missouri bottom. The heaviest yield of oats per acre in 1903 was in Boyd County, southeast of Spencer, and near Gross. Grain elevators are found at every railroad station. The reported acreage of the principal grain crops in 1902, not including Holt County, was as follows: Corn, 279,055; wheat, 105,981; oats, 115,958; rye, 12,680; barley, 4,877.

STOCK RAISING AND DAIRYING.

One of the most important industries in the region is cattle raising, and in many localities wide areas are used for grazing, especially where the land is too rough or too sandy for farming. The principal pasture lands are in the northern part of the Santee Indian Reservation in Knox County, in southwestern Knox County, in the

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sandy and rough portions of Holt and western Boyd counties, and on the bluff and ravine lands along Missouri River. Hogs, sheep, and horses are also raised in large numbers.

Dairying has attained an important place in the economy of the region. Cream is shipped from nearly all the railroad stations, Holt County leading in its production in the State of Nebraska.

TIMBER.

The timber growth is of considerable importance in most of the counties. It occurs mostly along the river and creek bottoms and up many ravines. The principal trees of economic importance are cottonwood, bur oak, elm, and scattering walnut; some of these are as much as 4, 5, or even 6 feet in diameter. The timber is used for posts, firewood, lumber, frames, and bridges. Sawmills operate at a number of points, as north of St. Helena, northwest of St. James, on Brooky bottom, and west of Aten. The sawmills obtain their timber principally from caving banks along the rivers, where the timber would be rapidly destroyed if not removed. The bur-oak growth is thickest in northern Dixon and Cedar counties, where it is cut into posts for which there is much demand. Timber cutting begins about September and lasts during the autumn and winter.

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